THE
MODEL ENGINEER

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THE MODEL ENGINEER

EVERY THURSDAY

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Our Cover Picture

One of the most attractive exhibits in the "M.E." Exhibition this year is the 1-inch scale reproduction of Hedley's well-known locomotive, popularly called *Puffing Billy*. The prototype was built at Wylam, Northumberland, in 1813, and now rests in the Science Museum, South Kensington. The model is the work of Mr. J. S. Youngman, of Chichester, who obtained all the necessary information from the prototype and then set to work to make a 1/12-scale replica. Although the model does not work by steam, all moving parts function in the proper manner and are faithfully reproduced exactly to scale. It is remarkable for the degree of realism achieved in its appearance, especially with regard to the successful and convincing rendering of the "antique" quality. Such a result is rare indeed in a model of this nature; every detail is correct in size, shape, position and appearance.

SMOKE RINGS

An "M.E." Exhibition Thought

IT IS probably correct that, as a nation, the British are not gregarious; yet in clubs and societies there is an undoubted tendency for the members to form themselves into isolated groups according to individual tastes. There is nothing basically wrong in such a tendency; it is only natural that, in a society which sets out to cater for all aspects of our hobby, these groups should tend to form. But what is not so easy to understand is that, very often, these groups isolate themselves individually from all the others; that is to say the locomotive people, for example, will have nothing to do with ships, power boats, cars or anything other than locomotives. To our knowledge, this sort of thing has led to the downfall and dissolution of more than one society, and it is much to be deplored. The true model engineer can and does take an interest in, and is able to appreciate, all phases of our hobby, without detriment to his own particular choice.

It is on this point that the "M.E." Exhibition exerts a powerful influence; every sort of model and all kinds of craftsmanship are presented for everybody to see and appreciate; the whole atmosphere is homely and friendly; in almost all sections there is something at which to marvel, and narrowminded indeed is the visitor, who goes away and thinks, for instance, that nothing but the locomotive models deserved his attention! Such a thought could scarcely be farther from the truth. We believe that most visitors depart from the "M.E." Exhibition wiser and better people than they were when they arrived. After all, we British pride ourselves on our reputation as sportsmen; and one of the attributes of a sportsman is the ability to appreciate the other fellow's point of view. We commend this thought to everybody concerned, because if it is acted upon, the entire hobby benefits and prospers.

More Than a "Hat Trick"

IT APPEARS that the paragraph under the heading "A Hat Trick?" in our July 30th issue was written under a slight misapprehension; for we have received a letter from the Birmingham Ship Model Society stating that, far from making a determined effort to win the Club Championship Cup at the "M.E." Exhibition this year, the society had reluctantly decided that *no* attempt would be made. The entries referred to have been sent in with the object of keeping the society's flag flying, so to speak.

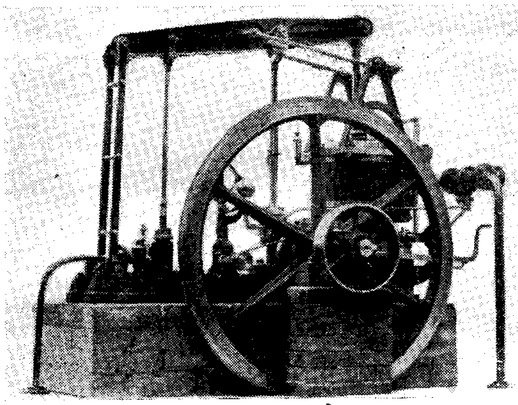
We are also reminded that the society has already performed the "Hat Trick" in 1951, followed by a further win in 1952. So, a win this year would be nearer a *double* "Hat Trick."

Back Numbers Wanted

ONE OF our readers who has been seriously ill, and is about to undergo his thirtieth operation in a Norwich Hospital has made an appeal for back numbers of THE MODEL ENGINEER prior to 1948 to help while away the long hours of idleness, and help to distract his attention from his painful affliction. We feel that many readers would be willing to help this deserving cause, and we suggest that anyone who has copies to spare should communicate with Mr. A. Woodridge, 38, Stannard Road, Norwich. We are also sure that readers will join with us in wishing him a speedy recovery.

A Correction

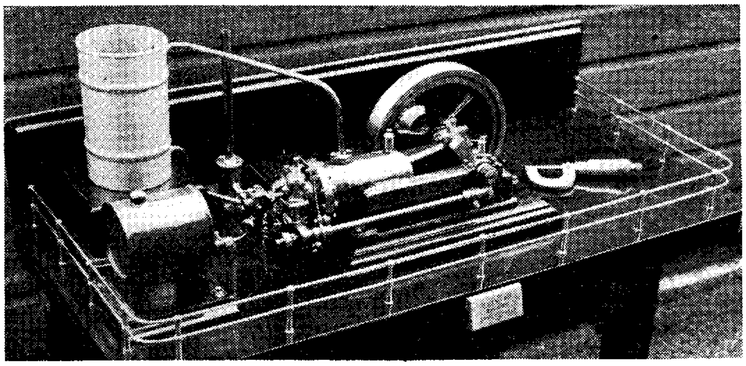
IN OUR issue of July 23rd, we published a notice of the *Bulletin of the British Light Steam Power Society*, and by some inadvertance, gave the wrong address of the society's secretary, Mr. T. F. Doyle; it should read: "Summerfield," Weir Place, Chertsey Lane, Staines, Middlesex. We offer our apologies for any inconvenience that may have been caused.



More about the

MODELS AT THE "M.E." EXHIBITION

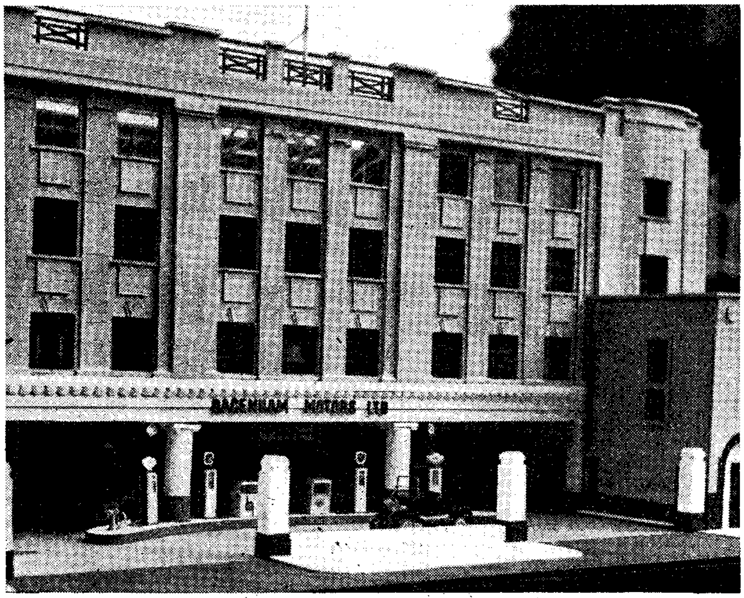
The 1 in. scale Easton and Amos Grasshopper beam engine by Mr. H. V. Davies



Mr. H. Dewhirst's model horizontal I.C. engine

SINCE the general review of models in "What to See at the 'M.E.' Exhibition" went to press, some further information on a number of the entries has been received, including a few photographs. Although most of these models have been briefly mentioned in the above review, readers will no doubt be interested to have the additional particulars and illustrations.

In the section devoted to mechanical working models, the model of an Easton and Amos Grasshopper beam engine, by Mr. H. V. Davies, of Morden, Surrey, represents a type of engine patented as early as 1803, but the prototype from which this model is copied was built in 1861. It was rather a small engine of its class, having a bore of 10¼ in. and a stroke of 16 in. An article by Mr. A. Ebeltoft (Norway), in the issue of THE MODEL ENGINEER dated March 31st, 1949, on a model of this engine, gave Mr. Davies the necessary information, also the inspiration for constructing the model shown here, which incorporates extra details including lagging on the cylinder, governor and reversing gear.



Mr. S. E. Hamilton's ¼ in. scale model of a modern garage

The model stationary internal combustion engine by Mr. H. Dewhirst, of Baildon, Yorks, appears from the photograph to be a very faithful reproduction of a full-size engine, in so far as is compatible with making a successful working model of reduced capacity, and adapting it to work on liquid fuel. It is to be deplored that this type of model, once extremely popular as a subject for model construction, seems to be in danger of extinction; it is true that the full-size horizontal open type engine has become practically obsolete, but this applies also to many other forms of engines which are still as popular as ever

for modelling. Few i.c. engines are so universally attractive in construction, working, and practical utility, and we would like to see more of them made.

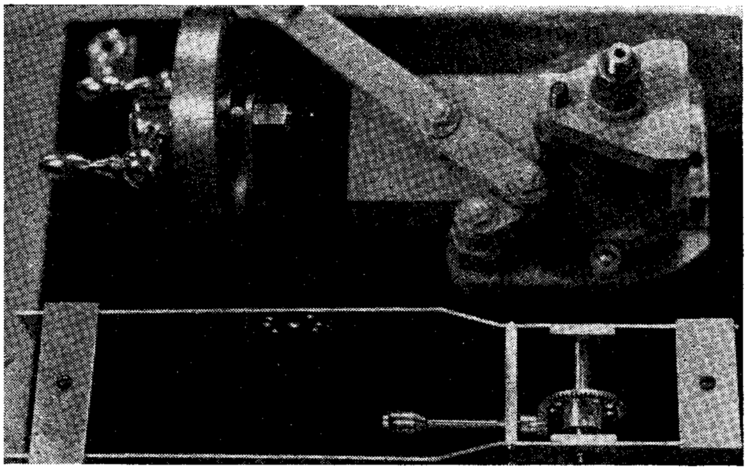
Among the tool exhibits, the special swivelling top slide and leadscrew index by Mr. H. E. Miller, of New Barnet, embodies several interesting features. The former item is equipped with a lever feed, the primary purpose of which is for shaping bevel gear teeth in the lathe, and its success in this function is shown in the bevel crown wheel and pinion in the chassis for a 1 in. scale model B.R.M. racing car in the foreground. The leadscrew index is also a valuable addition to the lathe equipment and appears to be very nicely made and finished.

Mr. T. A. Thompson's row of five 1 in. scale model shops has a realistic appearance, not only in the structures themselves but also in their contents. The height of the shops from ground level to top of fascia board is 13 in.; they comprise a grocer's shop with 15 in. frontage; a tobacconist and stationer's, 18 in.; a greengrocer's, 16 in.; a confectioner's, 17 in.; and a baker's 18 in. Each item in all the shops is made individually from wood or card, with the aid of a penknife, darning needle and razor blades; painted, and glued into place; a point of special interest is that the custard tarts in the baker's shop are complete down to the grated nutmeg on the top!

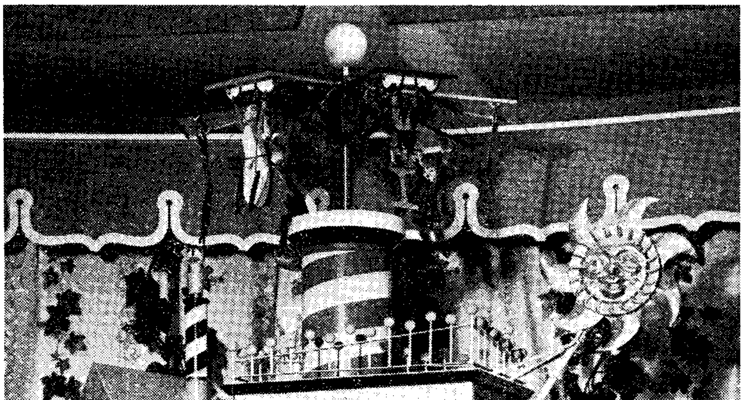
To judge by comparisons between photographs of Mr. S. E. Hamilton's model garage and the actual building, it would seem that fidelity has been very closely studied. Unlike many exhibits of this kind, which resemble stage or cinema "sets" in that only the frontage is complete, this model bears inspection from any angle. The model is built to a scale of ¼ in. to the foot, and comprises three floors, with forecourt and petrol pumps, also a model of a 1911 Model T Ford car, from an actual example housed on the premises.

One of the most unusual exhibits entered is a "Viatorium," or pocket sundial, by Mr. E. C. Woods, of Bowness-on-Windermere. This is based on actual "period pieces," though not an exact copy of any particular example. The instrument incorporates an inner magnetic compass dial for the purpose of orienting the "gnomon" which casts the shadow on the outer dial; there is also an elevation adjustment to suit the latitude of the place where the reading is taken.

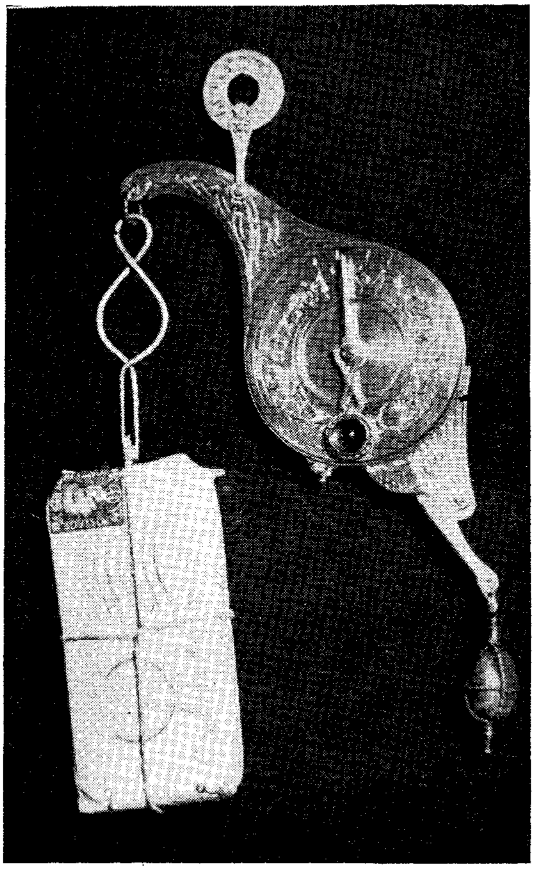
It is of interest to note that

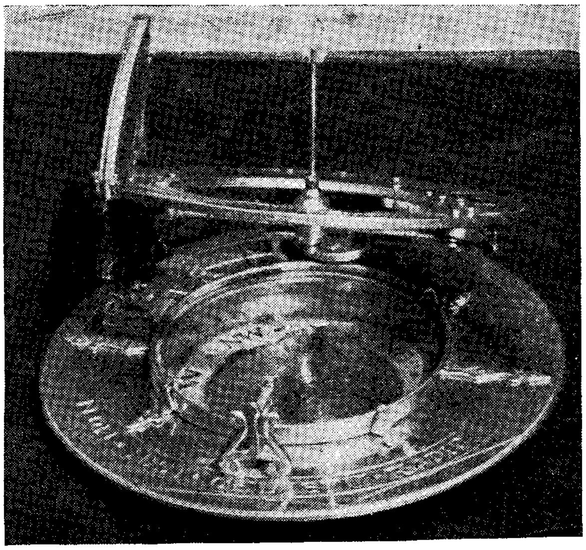


A swivelling top-slide and leadscrew index for the lathe by Mr. H. E. Miller, specially made for shaping bevel wheels seen in foreground

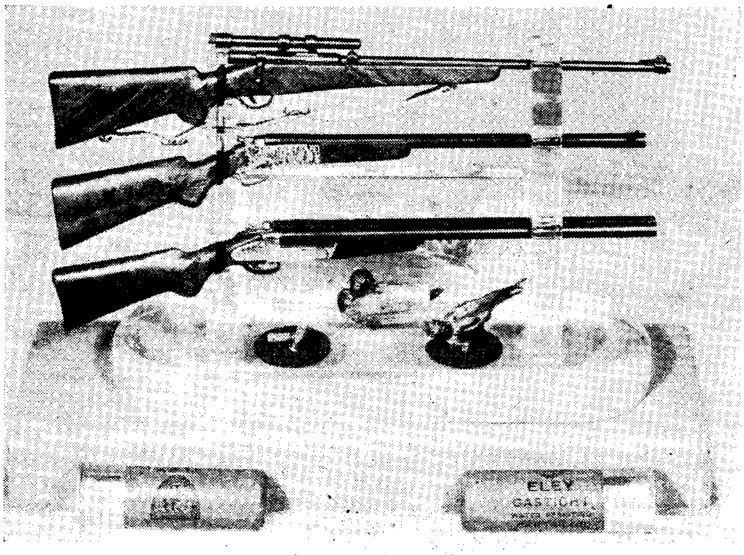


The working model of the Guinness Crazy Clock





(*Above*) *A Viatorium, or pocket sundial, and* (*left*) *a letter balance of antique design, both constructed from available data on " period " instrument maker's craft by Mr. E. Cuthbert Woods*



A group of model firearms and accessories to 2 in. scale, by Mr. L. E. Turnhill

Shakespeare, in one of his plays, makes a reference to a pocket sundial, which must have resembled this, in principle at least. The constructor observes that when the first pocket watches were made, with verge escapements, which were not noteworthy for the precision of their timekeeping, purchasers of these watches were advised also to buy a Viatorium, with an equation table, to enable them to set and regulate the watch !

Another item by the same constructor is an antique type of letter balance, operating on the beam scale principle, the design and ornamentation of which appear extremely interesting.

Marine Models

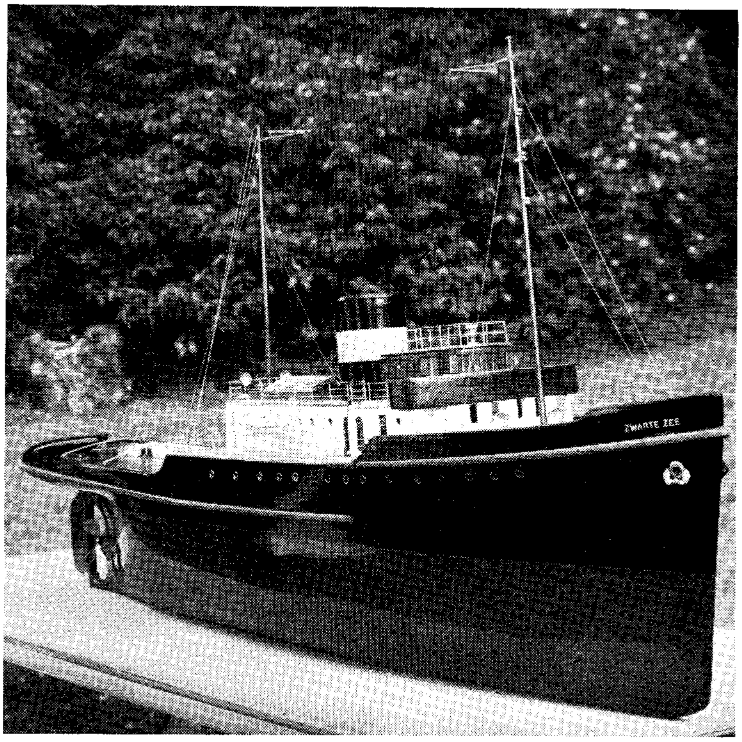
A very fine working model of R.M.S. *Queen Mary* has been entered, and in spite of her huge dimensions and the enormous mass of detail required to make even a reasonable model of such ships, both of the Cunard " Queens " are very popular prototypes for ship models. This is easily understood when one considers their lovely line and perfect proportions. These are more easily appreciated when reduced to model dimensions than when looking at the ships themselves. The ships when seen at close quarters, give an overwhelming impression of size, and it is only when they are viewed from some distance that their real beauty can be appreciated. Herein lies their charm as models, and their appeal to the builder. The model we are discussing was built by J. Glandfield of Richmond, Surrey. It is built to the scale of $\frac{1}{16}$ in. = 1 ft.

which gives a model nearly 6 ft. in length—a good healthy size for a working model. The underwater body appears to be to scale, and from the photograph we reproduce she floats at her correct waterline. The hull is built of wood with double diagonal planking on mahogany frames. The power is provided by four 6 to 12-volt electric motors, and the displacement of the model is 25 lb.

Another model which is well worth studying is that of the Bengal Pilot Brig *Fame*. This is, of course, in the Sailing Ship Section, and is entered by R. E. Brunsdon of Reading. This is a small model, being to the scale of 1/12-in. = 1 ft., but is well proportioned and has the delicately tapered spars which are so characteristic of a smart sailing ship model and which so few ship modellers seem to achieve.

Another notable model in this section is that of H.M.S. *Theseus* which was made by C. A. Burton, a C.E.R.A. of the Royal Navy. H.M.S. *Theseus* was a 74-gun ship of the 18th century, and was at one time Nelson's flagship. In the model the hull is planked and copper-sheathed, and even the lower deck is shown complete with its guns and carriages.

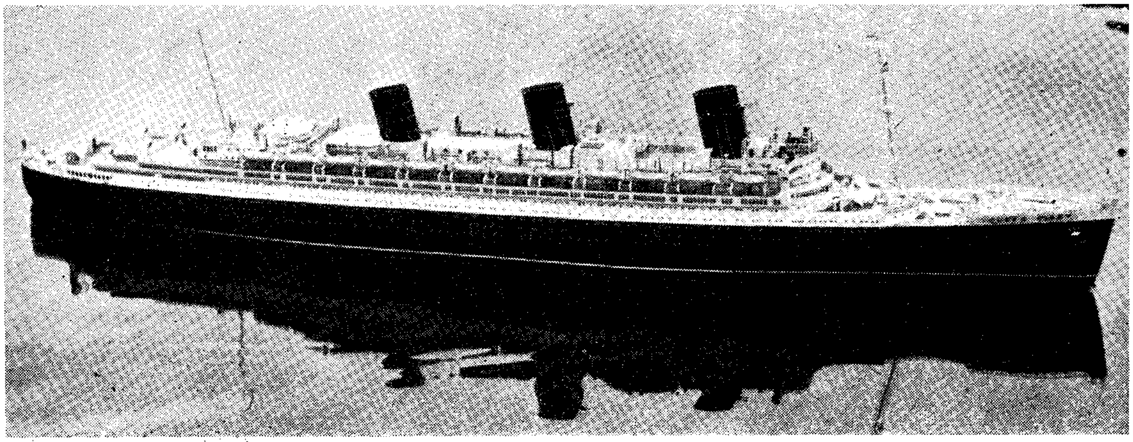
A miniature which we omitted to mention previously was a second model of R.M.S. *Scot*, the other being by Donald McNarry, as mentioned in last week's issue. This is by E. Kilner Berry of Worthing, who will be remembered for his series of articles "Waterline Models of Famous Ships" in our first volume of *Model Ships and Power Boats*. In the issue of July 1948, he described a model of this ship, and the fact that he has made a careful study of his subject is obvious from an examination of the model.



A working model of the well-known Dutch salvage tug by Charles H. Keeler

We are greatly interested in the model of the tug *Victor*, sent all the way from Australia, by Horace T. Sherer a member of the Melbourne Society of Model and Experimental Engineers. The model is based on the Melbourne Harbour Trust Tug of that name, and is a very nice piece of work.

Two beautifully finished models are those entered by Charles H. Keeler of Windsor, Berks. One is of a Marblehead yacht of Littlejohn design fitted with Vane steering gear. The other is of the Dutch ocean-going salvage tug *Zwarte Zee*. As will be seen from our illustration, this is a very fine example of a steam powered working model of a tug. Both these models are beautiful pieces of craftsmanship, and in each case the finish is exceptionally good.



A well-proportioned model of R.M.S. "Queen Mary," by J. Glandfield

Model Power Boat News

BY MERIDIAN

ORPINGTON AND WICKSTEED REGATTAS

WITH the co-operation of the Victoria M.S.C., the annual regatta of the Orpington M.E.S. was held as usual at Victoria Park, Hackney. The Orpington members are still without a water of their own, although "prospecting" has been done in the past year. Several possible waters have been located, but permission to use them has not been forthcoming. It is hoped, however, that with persistence it may one day be possible to hold a regatta on a home water.

A full programme of events made an interesting day's sport, and entries came from clubs as far apart as Bournville and Aldershot, besides most of the nearer ones. For an inter-club event, the large entry is a reflection of the growing popularity of competition work.

The Steering Competition for the W. Whiting Memorial Trophy proved an interesting contest, and the result was very open until one of the last competitors to run—A. Rayman (Blackheath), with *Yvonne*, scored three bulls in succession, and in a very convincing manner. Second was R. Curwen (Bromley) with *Vanessa*, proving that a radio-control boat can reach the targets without the control gear in action.

The racing events provided few surprises, but good average speeds for present-day racing. In class "B" J. Bamford (Aldershot) recorded another success with *Jab III*, and in Class "A," both first and second places went to the Orpington club, J. Ward, with his new boat *Dina*, recording 56.5 m.p.h., and G. Lines coming second with *Big Sparky* at 47.57 m.p.h.

Results

80 *yd. Nomination Race*
(1) A. Evans (Victoria), *Moiety*: error 0.44 per cent.
(2) A Banham (Victoria), *V2*: error 1.36 per cent.
(3) P. Cleary (Blackheath), *BH*14: 1.48 per cent.

500 *yd. Class "C" Race*
(1) C. Stanworth (Bournville), *Meteor IV*: 45.4 m.p.h.
(2) E. Woodley (Victoria), *Kathleen*: 40.1 m.p.h.

500 *yd. "C" Restricted Race*
(1) K. Hyder (St. Albans), *Slipper* 4: 58.4 m.p.h.
(2) W. Everitt (Victoria), *Nan*: 57.78 m.p.h.

Steering Competition
(1) A. Rayman (Blackheath) *Yvonne*: 15 points.
(2) R. Curwen (Bromley) *Vanessa*: 10 points.
(3) G. Jones (Victoria) *Fidelis*: 8 points.

500 *yd. Class "B" Race*
(1) J. Bamford (Aldershot) *Jab III*: 48.24 m.p.h.
(2) G. Lines (Orpington) *Sparky* 3: 46.49 m.p.h.

500 *yd. Class "A" Race*
(1) J. Ward (Orpington) *Dina*: 56.5 m.p.h.
(2) G. Lines (Orpington) *Big Sparky*: 47.57 m.p.h.

Wicksteed Regatta

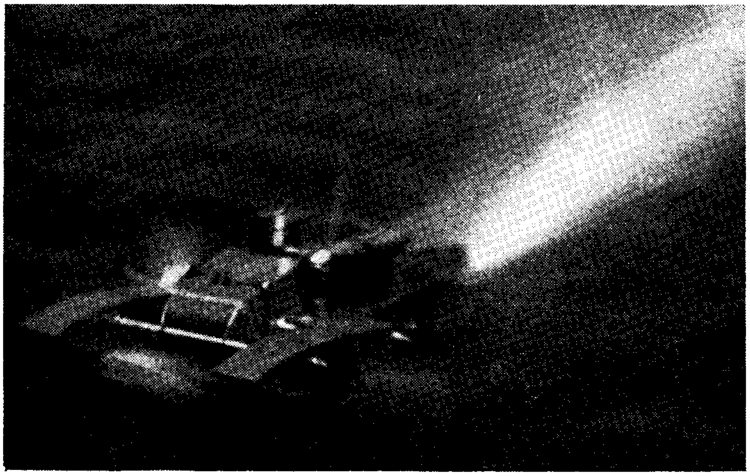
For the first time since the war the home club produced a competitor for the famous Class "A" races—the Newman Lowke Cup over 1,000 yd. and the Timpson Trophy over 500 yd.

The contestant for Wicksteed was W. Brightwell, with his 30 c.c. four-stroke engined boat, which is as yet unnamed. In the course of the racing, this boat exceeded the present 1,000 yd. record by 0.8 m.p.h. at a speed of 62.74 m.p.h. Unfortunately, this fine run cannot count as a record, as a minimum of 1 m.p.h. faster than the old record is necessary when establishing a new one.

The Timpson Trophy race, too, was won at an identical speed by this boat. Second place in both races was taken by J. Benson (Blackheath), with *Orthon*, at around 59 m.p.h. These two boats provided an interesting two-stroke versus four-stroke duel, ending with the honours going to the latter.

In the Class "B" race, G. Lines with *Sparky* 3 won at nearly 50 m.p.h., which is the best speed attained so far with this new version of *Sparky*. J. Rose was second in this race, with *Meteor I*. Mr. Rose

Mr. Rose (Bristol) assisted by Mr. Churcher, starting his "B" class boat "Meteor"



Mr. Morris's " A " class boat " Ned Kelley " (Bourneville)

is now a member of the Bristol club, although formerly of Coventry. This four-stroke job made many fine runs last season, and it is hoped that the move to Bristol will not prevent an appearance at some further regattas this season.

E. Woodley (Victoria), with *Kathleen*, was successful in the Class " C " Race, and this win is the reward of much effort expended in the past two seasons.

Results

Newman Lowke Cup, 1,000 yd. Class " A "

(1) W. Brightwell (Wicksteed), *W14*: 62.74 m.p.h.
(2) J. Benson (Blackheath), *Orthon*: 59.46 m.p.h.
(3) G. Lines (Orpington), *Big Sparky*: 53.83 m.p.h.

Steering Competition, Whitworth Cup

(1) A. Evans (Victoria), *Moiety*: 11 + 5 points.
(2) W. Phillips (Victoria), *Kenvera* 11 + 3 points.
(3) J. Burgess (Cheltenham), *Lady Maud*: 8 points.

Paten Cup, Class " B " 500 yd.

(1) G. Lines (Orpington), *Sparky 3*: 49.89 m.p.h.
(2) J. Rose (Bristol), *Meteor I*: 44.08 m.p.h.

Timpson Trophy Class " A " 500 yd.

(1) W. Brightwell (Wicksteed), *W14*: 62.74 m.p.h.
(2) J. Benson (Blackheath), *Orthon*: 58.78 m.p.h.
(3) W. Morris (Bournville) *Ned Kelly*: 43.8 m.p.h.

Douglas Cup, Class " C " 500 yd.

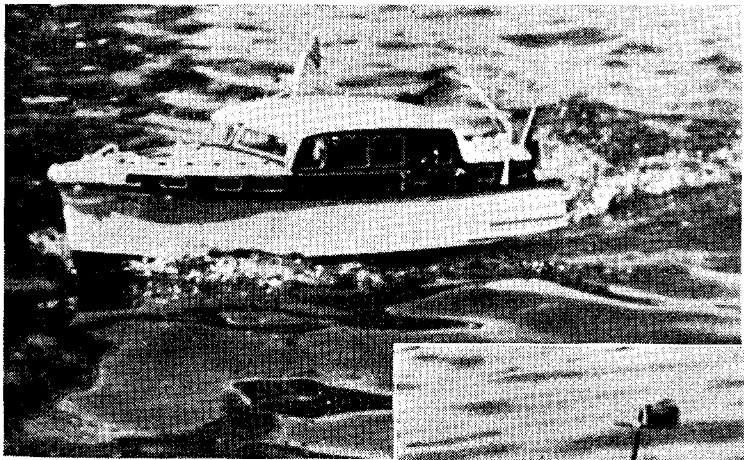
(1) E. Woodley (Victoria), *Kathleen*: 43.71 m.p.h.
(2) C. Stanworth (Bournville), *May II*: 34.44 m.p.h.

" C " Restricted Race 500 yd.

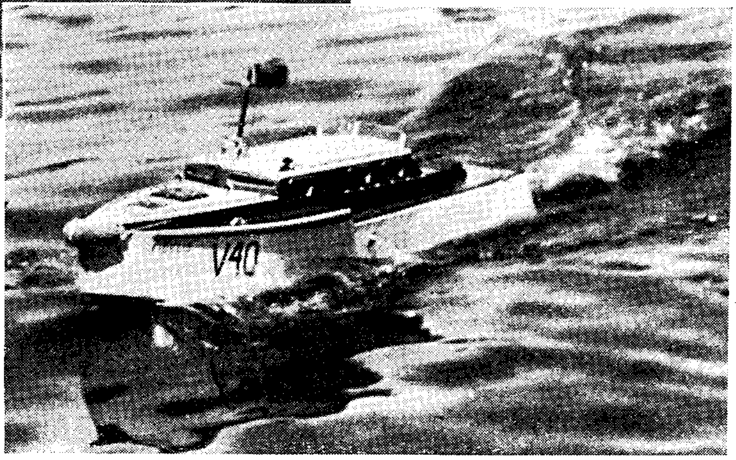
(1) K. Hyder (St. Albans), *Slipper I*: 58.44 m.p.h.
(2) W. Everett (Victoria), *Nan II*: 54.11 m.p.h.

Power Boat Waters—No. 2, Valley Pool, Bournville

Originally part of the Bournville Trust, this fine boating lake was transferred, together with the park,



(Above): Mr. Evans's petrol-driven cabin cruiser " Moiety "—winner of the 80 yd. Nomination race.



(Right): Mr. Jones's cabin cruiser "Fidelis," both of the Victoria M.S.C., in the steering competition at Wicksteed Regatta

to the Birmingham authorities. This change, which occurred some time prior to the war, did not affect the status of the Bournville M.Y. & P.B. Club, which has a fine boathouse near the water's edge.

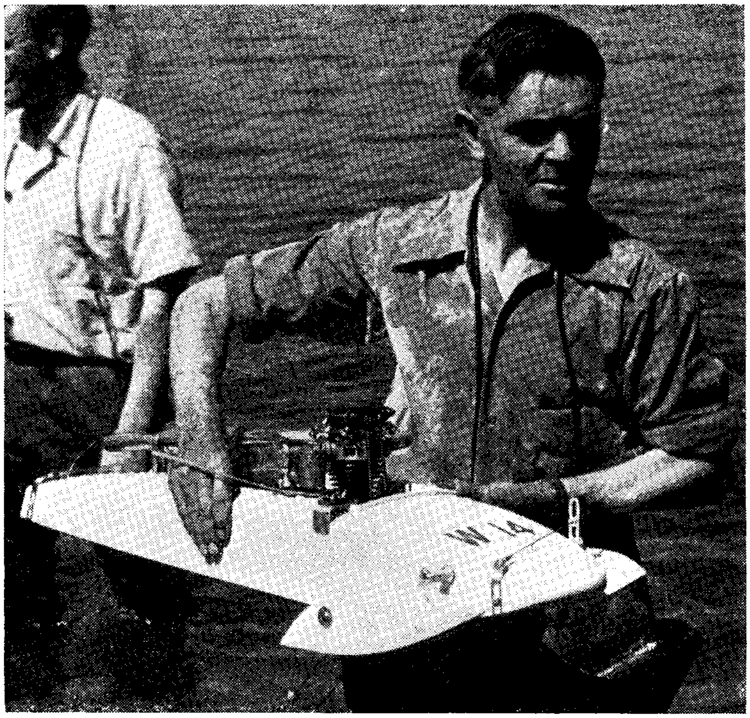
The Valley Pool is situated in Bournville Lane, near the junction of the Bristol Road, and may be easily reached from the centre of Birmingham by a short bus ride.

The lake is large and has concrete banks. The depth is around 2 ft., and a concrete bottom makes wading an easy matter. For circular-course racing, a socket is let into the concrete for fixing the pole centre.

As the water is fairly close to houses, the problem of noise is a matter that must always be recognised, and no running of power boats is permitted on Sundays. Generally speaking, the power boat section of the Bournville club confine their activities to Saturdays, certainly so far as racing craft are concerned.

The Bournville club is old-established, and the relations between the yacht and power boat sections are excellent.

An annual regatta is held at Whitsuntide, and this event has become an important one in the model power boat calendar. Boats are entered from both Northern and Southern clubs and the regatta is an opportunity for a "get-together" between enthusiasts who normally see little of each other—not to mention the various boats entered for the racing.



Mr. W. Brightwell (Wicksteed M.Y. & P.B.C.) with his four-stroke engined "A" class boat

A GOOD TUCK IN

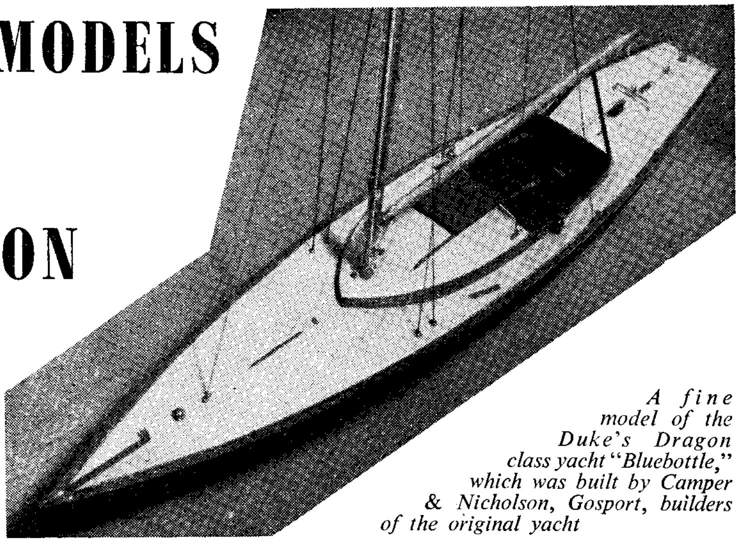
OLD George Pattison stood looking at a "fresh chap" who had just been started. George was a really nice old fellow who liked his pipe and also liked a good job. "And what class of work hast been used to, young fellow?" says George.

"Well, I done most of my time in the motor industry. I'm afraid I'll be a bit strange with this work. I know very little about maintenance and steam plant, but I'm willing to learn." "That's the spirit," says George, "don't be against asking. You know, we had a chap here some weeks ago and he had some nice tools, micrometers and suchlike, but I knowed he wasn't much good for this class of work. He come one day and asked if I had got an adjustable square. I said I didn't know there was such a thing, so I took him over to my tool box and said, 'Now, then, what's it like?' After looking the tools over, he picks one up and says 'This is what I want.' 'And that's what you call an adjustable square,' says I, 'Well, let me tell you, that's a bevel gauge and always has been.'

"Another time when we had the 'middle' boiler off for inspection, he comes along and says, 'The manhole cover joint was miles too big.' So I says "Come along and let's see the trouble,' picking the asbestos joint ring you know, I got it between my finger and thumb of each hand and pressed it all round together, making it smaller in diameter and a good fit on the lid."

"Oh!" says George, "I'm looked on as a back number but I've seen some fun. Do you know we sent to the Labour Exchange once for a boiler fireman and they sent us a likely looking man and when I asked him about his experience he asked me what the two glass pipes (meaning the water gauges) was for. After that, I told him I had some more applicants to see and I would let him know, which I did, *and* the Labour Exchange!"—P. ROBINSON.

THE DUKE'S MODELS at the EXHIBITION

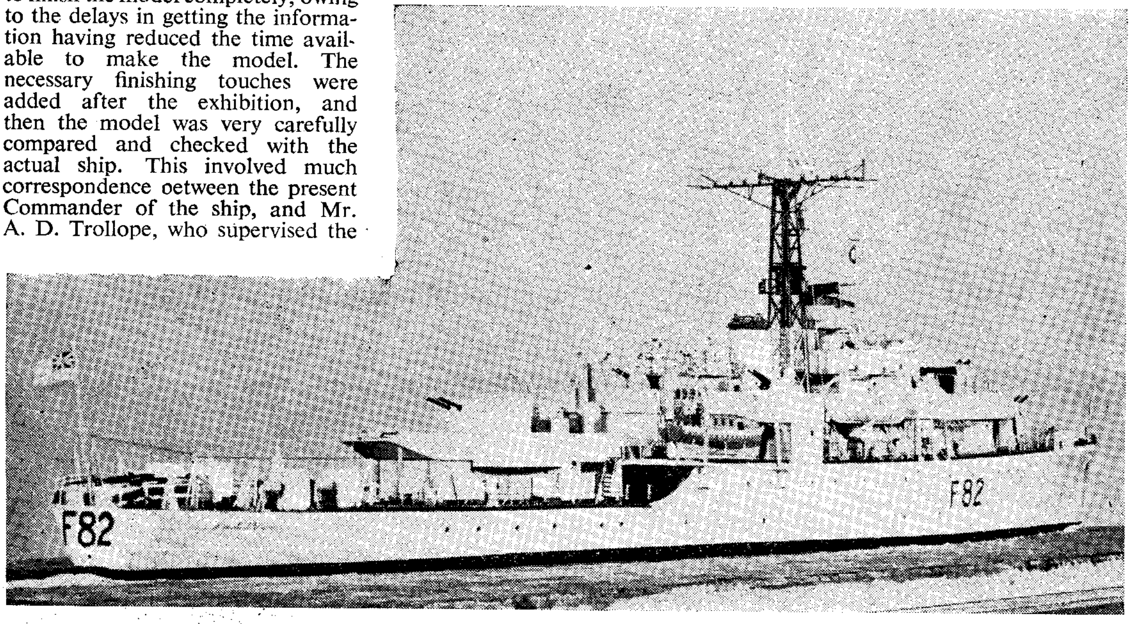


A fine model of the Duke's Dragon class yacht "Bluebottle," which was built by Camper & Nicholson, Gosport, builders of the original yacht

OUR exhibition has been greatly honoured this year by the loan graciously made by H.R.H. The Duke of Edinburgh of two ship models from his collection. We welcome this proof of his interest in ship modelling, and, following as it does on his consenting to open the Exhibition last year, and remembering his extremely keen interest in the models and the craftsmanship involved, when he toured the exhibition afterwards, we feel sure that all model makers will be encouraged to go on making more and better models, and to think even more highly of their craft.

One of the models lent us is that of H.M.S. *Magpie* which was presented to His Royal Highness when he opened the exhibition last October. At the time it was presented, it had been found impossible to finish the model completely, owing to the delays in getting the information having reduced the time available to make the model. The necessary finishing touches were added after the exhibition, and then the model was very carefully compared and checked with the actual ship. This involved much correspondence oetween the present Commander of the ship, and Mr. A. D. Trollope, who supervised the construction of the model. Photographs were exchanged, and any discrepancies which were found were rectified, so that the finished model as it now stands may be taken as representing accurately the ship as she was when the Duke commanded her. Naval vessels, as is well known, are modified from time to time, not so much in classes as in individual ships. The problem of keeping track of these modifications is what makes it so very difficult to make an accurate model of any particular naval ship.

The other model from His Royal Highness's collection is that of his Dragon type yacht *Bluebottle*. This was made by Messrs. Camper and Nicholson of Gosport, the builders of the original, to the scale of ½ in. = 1 ft. It is a fine example of the scale model of a full size yacht. The difference between a full size yacht and a model racing yacht will be appreciated by a comparison of this model with one of the model yachts in the Competition Section or on the Model Yachting Association stand.



Model of H.M.S. "Magpie" presented to the Duke at last year's "M.E." Exhibition

READERS' LETTERS

● Letters of general interest on all subjects relating to model engineering are welcomed. A nom-de-plume may be used if desired, but the name and address of the sender must accompany the letter. The Managing Editor does not accept responsibility for the views expressed by correspondents.

CAMERA CONSTRUCTION

DEAR SIR,—I would like to see published in THE MODEL ENGINEER more details of miniature camera construction, and I hope it will be possible to publish details of the cameras made by your correspondent E. D. Winn. I am attempting the construction of the camera described by G. Pratt. I have one complaint with respect to the articles on miniature cameras which have appeared from time to time, and that is lack of detail and dimensions, which I find rather annoying. Take the camera and flashgun described by G. Pratt; this was done in two short articles, and covered the making of a range finder. Apart from the foregoing, I have nothing but praise for THE MODEL ENGINEER and the interesting articles which appear therein.

Yours faithfully,
Crook. J. CLARK.

A.C. MOTOR GENERATORS

DEAR SIR,—In the article "Hints on D.C. Electric Motors," by F. Roberts, July 23rd, 1953 issue, I find that the paragraph on obtaining a.c. from a d.c. motor is not correct as a general statement. The method given of connecting up diametrically opposite commutator bars will only hold true for machines having an odd number of pole pairs, i.e., two, six, ten, etc.

Fig. 11 and 12 in the article show two four-pole machines, and to get the maximum a.c. voltage, connections must be made to commutator bars at 90 deg. to each other. If connected up as stated in the article, a very small voltage (if any) will appear across the slip-rings, for these are equi-potential points on the armature.

A simple formula for determining the correct angle at which to connect up the slip-ring is:—

$$O = \frac{360}{P}$$

where P = No. of poles.
O = angle required in deg.

Thus for a six-pole machine, O = 60 deg. and so the first slip-ring will be connected up at an arbitrary commutator bar 0 deg., and the other at 60 deg. to it.

There are two further points on the commutator, either of which could be used with the one at 0 deg. These points be determined by the use of the slightly more complicated formula:—

$$O = \frac{360}{P}(1 + 2n)$$

where $n = 0, 1, 2$, etc., which gives for the six-pole machine:—

O = 60, 180, 300, 420 deg., etc.

(420 deg., of course, is 60 deg. + 360 deg., so arriving back at the first position.)

Hence, first ring at 0 deg., second at 60 deg., 180 deg. or 300 deg.

Yours faithfully,
Deal. H. IVORY.

NAVAL INCIDENTS

DEAR SIR,—Your amusing article headed "The Retort" in THE MODEL ENGINEER for June 25th, 1953, is one which I fully appreciate, having spent the full period of the late war as a "hostilities-only" ordnance artificer in the Royal Naval Special Reserve. During my service on one of the K.G.V. class battleships, several such incidents as related by your correspondent P. Robinson were encountered, but the following episode was the last and most amusing in which I was involved.

The "cease fire" in the war against Japan had been ordered. We were in a position a few hundred miles west of the Japanese mainland and making our leisurely way towards Yokosuha, the Japanese naval base. Orders to paint ship, where possible, were given, but A.A. alertness was to be rigidly maintained, in case the odd Kamikaze pilot decided to prolong the war a little longer on his own account.

The ship's superstructure was largely re-painted by Sunday morning when hands were ordered to divisions and church on the fo'c'sle, the first time for many moons. The writer "stood fast," being ordnance artificer on watch. Divisions had hardly commenced when a magslip motor in a turret receiver was reported defective. These small electrical motors can be changed in a matter of minutes, provided they are accessible, which is not normally the case. Accessibility can be achieved in two ways as follows: The "book" states that an inspection plate approximately two feet square, and one inch thick should be removed from the casement, thus exposing the back of the receiver. It should here be stated that the plate is secured by "umpteen" ⅞ in. countersunk and slotted bolts. Experience once proved this to take three days—the bolts had to be drilled out.

We lazy "hostilities only" artificers discovered an easy way to success as follows: The receiver, complete with the offending motor, was removed bodily from its mounting, by the removal of four half-inch bolts "all nice and dry" inside the gunhouse. Electric leads were not disturbed, as they were sufficiently long and flexible to allow the instrument to be placed on the gunhouse deck, ready for the electrical artificer to change the magslip.

On the occasion in question, the writer and the E.A. (also a "hostilities only" man) completed the job in twenty minutes. The gun crew duly "tested through" and reported all O.K. to the gunnery officer. It appears the news of the break-down had reached the ears of the ordnance officer. Whilst at divisions, he worked out a plan to have it corrected without delay. Immediately after church, the officer entered the workshop with a cut and dried plan, only to be informed by the writer that it was already completed and tested through. He spent the next half hour checking up, and finally agreed all was apparently O.K. Our method had then to be described, after which I was ordered to stand to attention and informed that the war was now over and things would in future be done as laid down in the "book".

The grave danger, it appears, was the possibility of re-assembling a drive through an Oldham coupling 180 deg. "out."

The only redeeming feature of the whole affair was the preservation of the new paint on the inspection plate.

Yours faithfully,
Cape Town, S.A. "TIFFY."

MACHINE SLIDE ADJUSTMENT

DEAR SIR,—I have noticed in modern machine slides that the gibs are sometimes held in by pointed screws which have a lock-nut to secure their adjustment. I compare this with the older method of making the screws pointed but with a stub central portion cylindrical.

The older method separates the dual duty of the gib-screw, which has not only to adjust the gib, but also retain it in position when the slide moves.

Yours faithfully,

Crowborough. J. C. DAVIS.

CAMERA DESIGN

DEAR SIR,—I do not understand the penultimate paragraph of Mr. Winn's letter in the July 16th issue. There is no need to reduce the length of film in a 35 mm. camera, or to wait until 36 exposures have been made.

Expose any number of frames from one upwards. Take the camera into a dark room (no light at all), with the developing tank. Wind on half a frame, open the back, cut through the film near the cassette with a small pair of scissors (don't scratch the lens doing this). Remove the exposed film from the take-up spindle, and place it in developing tank. Rethread from cassette in daylight as usual.

True, this wastes a frame or two, but with 50 ft. of film at 15s., this is only a half-penny a frame.

Yours faithfully,

Norwich. S. H. ROBINSON.

BRITISH CRAMPTON LOCOMOTIVES

DEAR SIR,—On coming up from Hampshire recently for a brief return to look after some little matters, I was delighted to find the copy of THE MODEL ENGINEER with the 5th instalment of the "Crampton" article. I would not for anything miss one of this series; for I agree most whole-heartedly with you about the excellence of the drawings; and, indeed, I think Mr. Twining has put all students of the locomotive under a load of gratitude for what I think is the most important monograph of locomotive history that has appeared for years. It is rare indeed, to find so fascinating a subject dealt with by a writer who possesses at once the technical and historical knowledge, and the remarkable artistic ability that Mr. Twining brings to his subject.

Yours faithfully,

Isleworth. J. C. COSGRAVE.

CUTTING CYLINDER LATCH KEYS

DEAR SIR,—With reference to the article in the issue of August 6th, by Mr. S. E. Capps, the author states: "Keys made locally for these locks can only be obtained to an existing key."

We are only a small family establishment, but for several years we have been cutting new cylinder keys to the lock as supplied by the customer, *without any key*. Also, master keying existing series of cylinder locks.

The plungers and springs are not removed by filing away the top of the block. Nor is a key held in place by a wire. The only thing is that the key is *always* cut first, and the plungers fitted to the lock, unless otherwise required.

But we would like to point out that a cylinder lock should *never* be oiled. Lubrication by graphite is the safer method, since oil often causes a hydraulic effect in the spring chambers.

Yours faithfully,

Great Yarmouth. D. G. DANIELS.

AN EARLY "M.E." REGATTA

DEAR SIR,—It may be interesting to all those model engineers, who run model power boats, to learn that it was on Saturday, July 25th, 1908, that THE MODEL ENGINEER held the first regatta at Wembley Park; open to all model boat men in England. I remember it well, and as a member of the Victoria Park M.S.C., I took part. We all met at the Boat House, Victoria Park, about half past 5 a.m., and there was Mr. Blancy very busy cooking eggs and bacon on an oil-stove for breakfast. Very soon a horse and van arrived, and in went both boats and owners, all the way to Wembley Park; I may as well say that we stopped at a few "hurdles" on the way. After the racing, the prizes were given out in a tent which was lit up with oil-lamps—and this was only 45 years ago. I often wonder whether there are many who took part in this regatta still running boats.

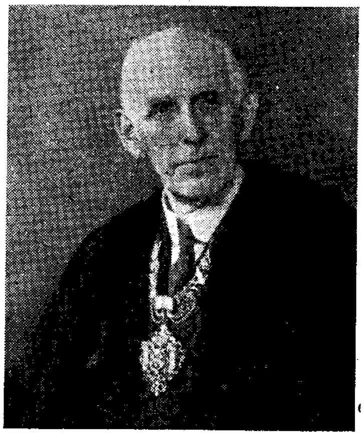
Yours faithfully,

Lewisham, S.E.13. "Leda III" (E. W. VANNER).

Who's Who IN MODEL ENGINEERING

VICTOR B. HARRISON

One of the outstanding features of the many types of models made and described in "The Model Engineer" by Mr. Harrison during the course of his long model-making career is their realism, not only in external appearance, but also in working character. He has devoted a great deal of experiment to the design of model steamers, locomotives and railway equipment, and one of his achievements, in co-operation with Messrs. Courtice and Relph, was the development of an effective system of automatic speed control for steam locomotives on scenic railways. His active interest in making models began in 1897, at the age of twelve, when he contrived to build an electrically-driven model boat, and also laid the foundations for a model railway with a Gauge "1" wagon built from a set of parts, followed by other wagons and coaches to the designs of the late Mr. Henry Greenly. He was educated at Highgate School, and took up printing as a career, rising to the highest rank of this profession; his portrait shows him in the robes of the Master of the Stationer's Company, which office he held in 1946-7. Later model activities were on an increasingly ambitious scale, and he has won several awards at "M.E." Exhibitions, including a bronze medal for a 6 ft. model of the *Mauretania*, and silver medals for two G.E.R. *Hook of Holland* steamers, two free-lance cargo steamers, and a free-lance frozen-meat ship. He is a member of the London Society of Model and Experimental Engineers, also a past vice-president of the Model Power Boat Association.



HAND TRAVERSE FOR THE LATHE SADDLE

By " Duplex "

ON reading an admirable article, published recently in this journal, on fitting a geared hand-drive to the lathe leadscrew, it came to mind that the same problem had been met with, and solved after a fashion, on two occasions previously.

The leadscrew of a Britannia lathe bought new in 1922 was fitted at its right-hand end with a thrust-bearing of the type illustrated in Fig. 1. This form of construction did not readily admit of the attachment of a handwheel to the leadscrew in this situation.

Again, when a 120-mm. Boley lathe was bought in 1931, it was found that not only was there no extension of the leadscrew for attaching a handle, but also the

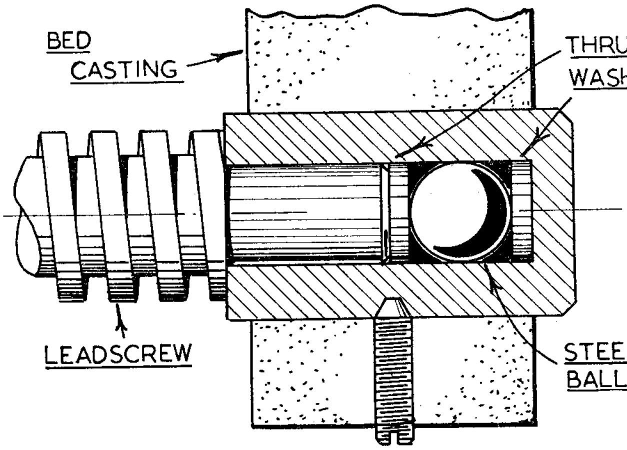


Fig. 1. Diagram of the leadscrew thrust-bearing fitted to an old Britannia lathe

great length of the bed would mean an uncomfortably long stretch for the right arm if a handwheel were fitted in this position ; that is to say, when working seated at the lathe. There are some, including ourselves, who hesitate to alter a valuable machine tool so that it becomes no longer of the standard pattern, for this may be a matter of some importance should the lathe later be offered for sale.

When, therefore, fittings are added to the lathe, it may be more satisfactory to know that the machine will be left intact after any additions have been removed.

Working on these lines, it was decided in both the above instances to attach an operating handle to the inner face of the lathe quadrant to drive a change-wheel, meshing with a second wheel secured to the left-hand end of the leadscrew in the normal manner.

In this way, it seemed that not only would the driving handle be conveniently placed for turning with the left hand, but also any ratio of gearing could be selected at will.

This fitting, which was removed and retained on selling the Boley lathe for war work, is illustrated in Fig. 2, and in the accompanying drawing showing an exploded view of the components.

The dimensions given in the subsequent drawings are those of the actual attachment, but a similar type of fitting would be suitable for most lathes lacking a place of attachment for a leadscrew handle.

Making the Attachment

The bushing C is clamped to the lathe quadrant by the washer and threaded collar B ; the spindle is shouldered and threaded at either end, and at the left carries the change-wheel mounting D and on the right the operating handle A. After the bushing D has been screwed home on the spindle and the change-wheel mounted in place, the assembly is securely held by tightening the nut E. A key can be fitted to the bush to engage the keyway in the wheel, but without this, the fixing was found to be amply secure for taking the light turning pressure applied when working. After the handle has been screwed on to the end of the spindle, it can be permanently fixed in place by expanding a coned centre drilled in the end of the shaft, or the end of the spindle can be riveted over as shown in the drawing. Where the leadscrew is of metric pitch, as in the Boley lathe, the revolutions of the handle can be made to correspond to fractional-inch measurements by arranging a wheel train incorporating the transposing wheel supplied with the lathe. In addition to turning the leadscrew, the attachment can be made to turn the lathe mandrel and, here, a wheel train giving a reduction ratio in the

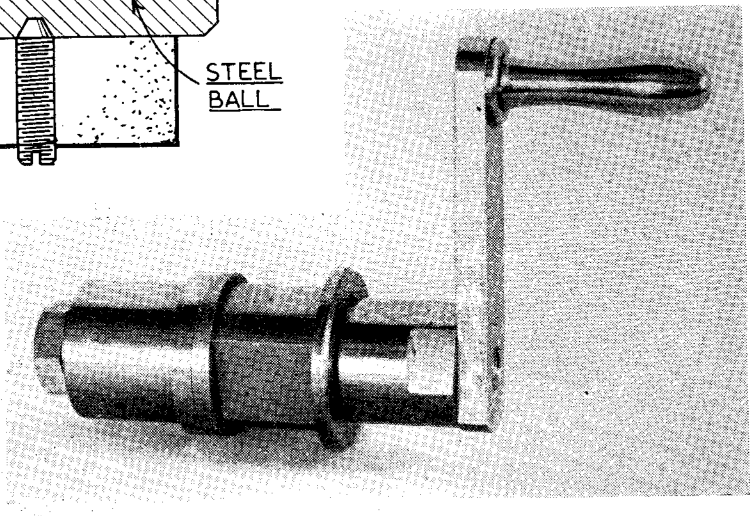


Fig. 2. Lathe quadrant attachment for turning the leadscrew by hand

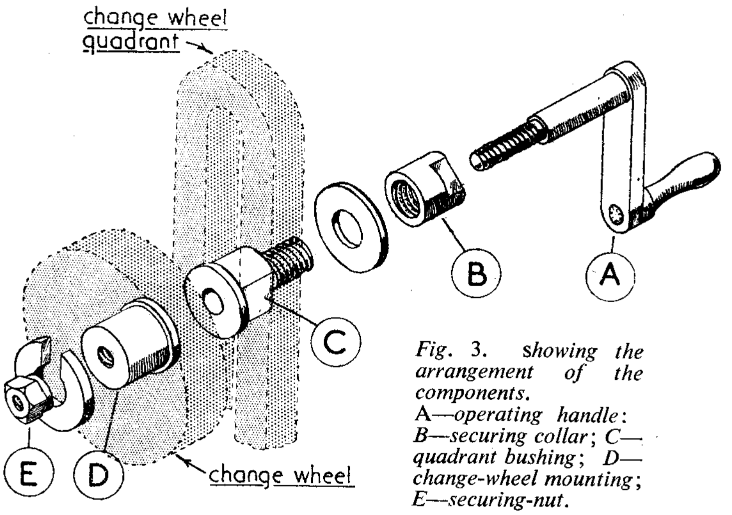


Fig. 3. Showing the arrangement of the components. A—operating handle: B—securing collar; C—quadrant bushing; D—change-wheel mounting; E—securing-nut.

other work face, so precise was the action of the throw-out that, at the finish, the work hardly needed a surfacing cut.

While on this subject, it might perhaps be opportune to put in a plea for the more exact use of the term "precision" as applied to machine tools.

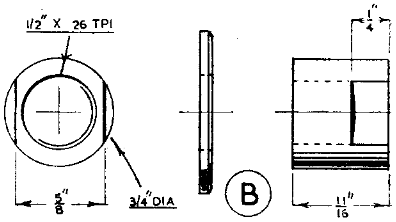


Fig. 4. Collar clamping the attachment to the quadrant

drive may be found useful when threading chucked work by means of taps or dies mounted in the tailstock.

In his instructive article, Mr. K. N. Harris refers to the automatic throw-out fitted to the clasp-nut of the Boley lathe, and a brief reference to this cleverly designed and beautifully made piece of mechanism may be of interest to readers ; but hardly, one fears, to many lathe manufacturers, as it would be ruled out on the score of expense. There are two sliding plates or adjustable stops controlling the throw-out in either direction of the saddle's travel. When, with the lathe tool touching the work, one of these stops has been set and then clamped in the slideway on the vertical face of the bed, the saddle is backed away and the clasp-nut closed. The plunger operating the clasp-nut is actuated by a strong spring and is controlled by a sear. As the saddle advances, the sear, on meeting the stop, is tripped and the clasp-nut opens.

Not only does this action take place almost instantaneously, but it is quite positive and independent of the cutting pressure on the tool, unlike some throw-out mechanisms where the operation is more gradual and less reliable. In practice it was found that, when a series of cuts was taken up to a deep shoulder or

There was a time when a precision tool was not only of somewhat massive construction, but also embodied certain essential features of design, including a hardened and ground mandrel running in hardened steel bushes, very high finish of all slides and feed-screws, accurately located, large gib-pieces for adjusting the slides, and a fine-feed tailstock with lapped barrel guided for the full length of the tailstock casting.

Moreover, the manufacturers used to supply test charts of individual machines, and the errors in even a long lathe bed amounted to only a few ten-thousandths of-an-inch.

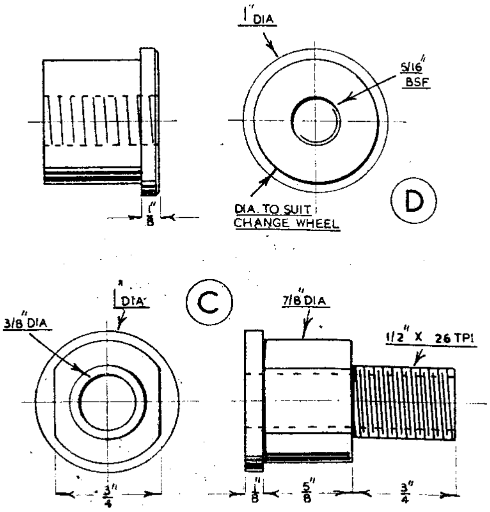


Fig. 5. C—quadrant bushing; D—change-wheel mounting collar

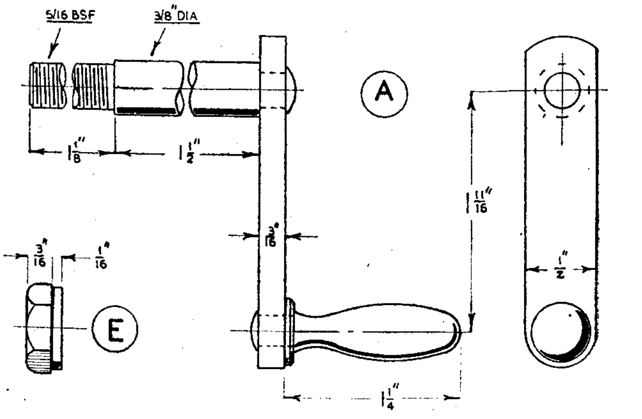


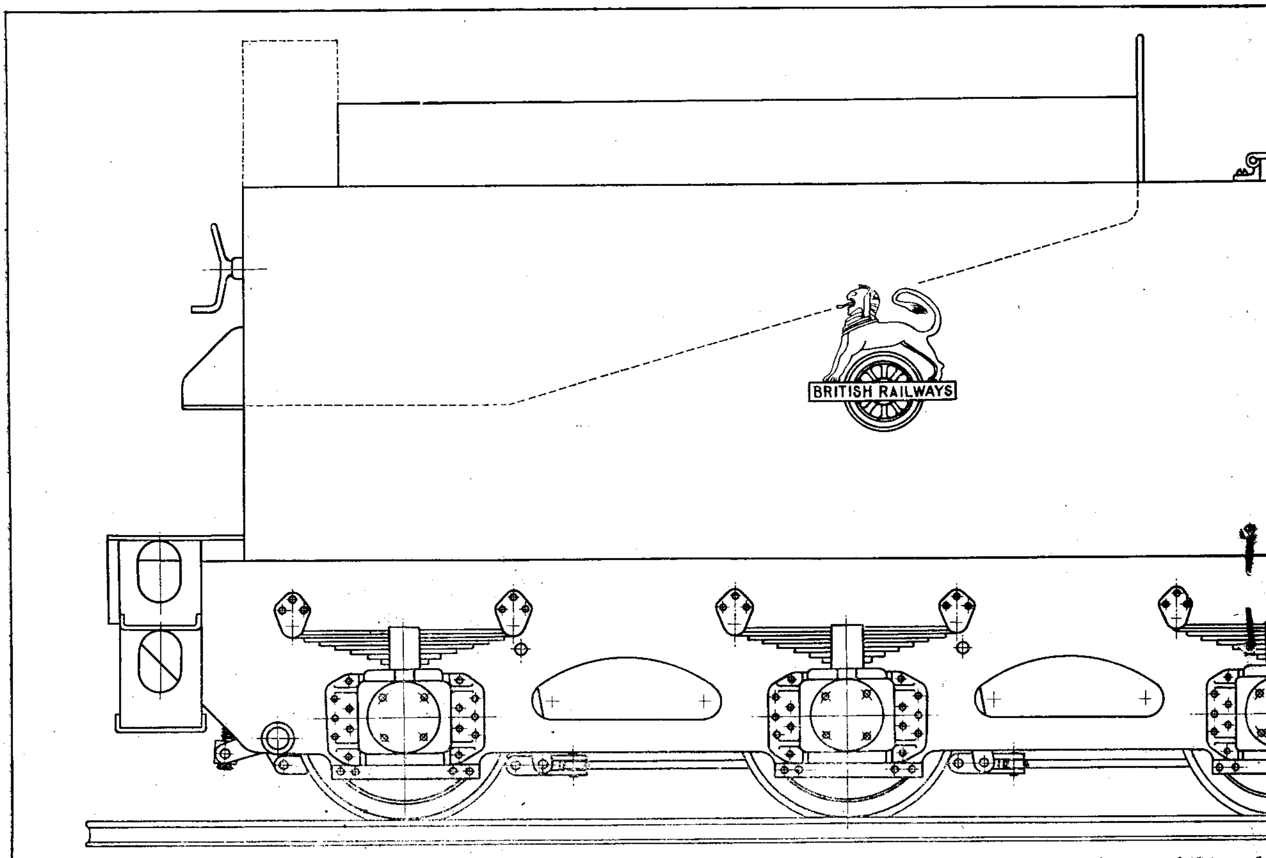
Fig. 6. A—operating handle; E—change-wheel securing-nut

L.B.S.C.'s "Britannia" in 3½ in. Gauge

• CONSTRUCTING THE TENDER

SINCE writing the last instalment of this serial, I have received several requests to hurry up and give the general arrangement drawing and first details of the tender, as some builders are right up-to-date with the job, and want something to get on with, whilst awaiting description of the few oddments required to finish off the engine part. Your humble servant always being willing to oblige wherever possible, here are the requested tender drawings. To try and please the greatest number of builders, I'm just shunting the final engine oddments into a siding for the time being, but will include them along with the tender details, and I hope everybody will be happy !

This tender, as you will notice, is different from anything that I have hitherto described. Personally, I reckon it is terribly ugly; it could have been made far prettier without sacrificing anything in the way of utility. The tender of my *Tugboat Annie* is far more symmetrical, is of equal capacity, contains all the necessary blobs and gadgets, and is easier to build. Howsumever, as the poet is reputed to have said, it is none of my business; I guess Messrs. Riddles, Cox & Co. had the best of reasons for what they did—they usually have ! Anyway, the tender differs from any of its ancestors, by having no soleplate. The body, or tank, is like a box with rounded top and bottom edges, mounted directly on the frame plates; it reminds me of modern motor-car construction. The coal bunker is a sort of hopper made separately and fitted into the tank, projecting well above it. The fireman's shovelling plate extends well forward into the cab of the engine, enabling the fireman to keep well clear of the gap between engine and tender, as there is no flap or fall-plate. The brake handle is mounted horizontally, operating the spindle by means of bevel gears, like the reversing gear on the engine. On the full-sized job, a similar handle operates the water scoop, but we shan't need that one. The axleboxes are large, and are fitted with Timken bearings; and there is a windshield or weather-



Elevation and back end view of the tende

board at the footplate end, to afford protection to the driver and fireman when running tender first.

Variations on the Small Tender

As with the engine part, I have made a few departures from full-size practice, to simplify the detail work, while retaining as much of the personal appearance of the big engine as possible. This should please the friends and relations of Inspector Meticulous. The back weatherboard is left out, for a start, because if it were fitted, you couldn't get at any of the handles in the cab. That is the one big trouble when designing a locomotive for 3½-in. gauge; you can't ride in the cab, so have to make provision for driving from behind the tender. No water-scoop being required, there will be no need to fit two sets of brake pull-rods, as one central set will do all that is needed.

We shall need an emergency hand-pump in the tender tank, and this requires a long filler-hole with a hinged cover, to enable the pump extension handle to be operated through it, if ever it should be needed. Genuine Timken bearings are not available in a size small enough to suit the 3½-in. gauge axleboxes, so we shall have to substitute ordinary ball-bearings; but plain bearings may be used if desired, and can be accommodated in the same type of axlebox. The pipe work is simplified, and arranged to suit the connections already illustrated for the engine. That is about all there is to worry over, so we can now go ahead with the job.

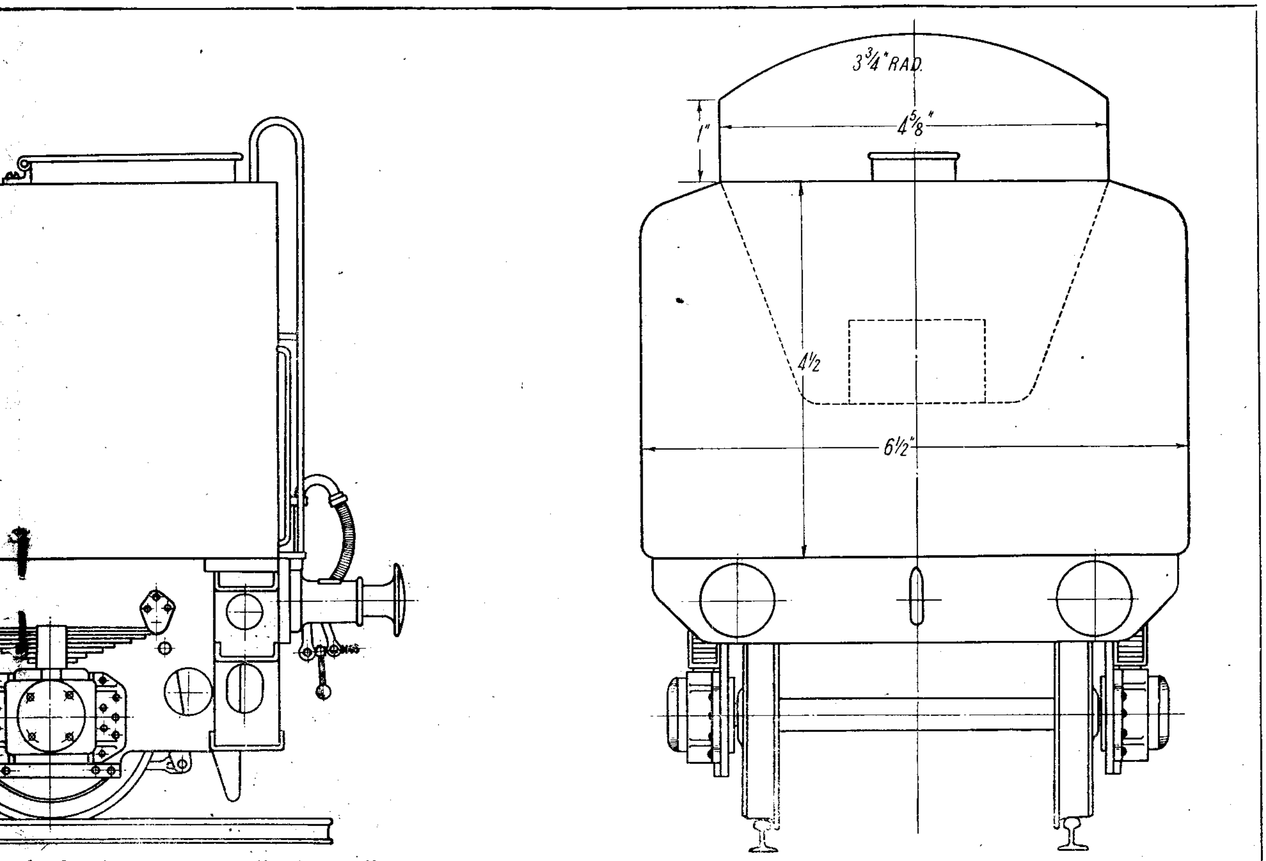
Tender Frames

For the frame plates, two pieces of 3/32 in. or 13-gauge soft mild sheet steel, bright or blue, will be needed, 16¾ in. long and 2¾ in. wide; this will allow for cleaning up. The usual procedure is followed for cutting out; mark out one plate only, drill a couple of the rivet or screw holes, use as a jig to drill the second plate, temporarily rivet the plates together, and saw and file to given outline and dimensions. The openings can be cut very easily with an Abrafile, or a Tyler spiral blade, as these gadgets cut "around the Johnny Horners," and it isn't necessary to drill around the outline of the hole, and then break out the piece and clean up ragged edges with a file. The only disadvantage is, that they need guiding very carefully otherwise they are prone to "run off the road." Before parting the plates, mark which is the outside of each; and after parting, file off any burrs.

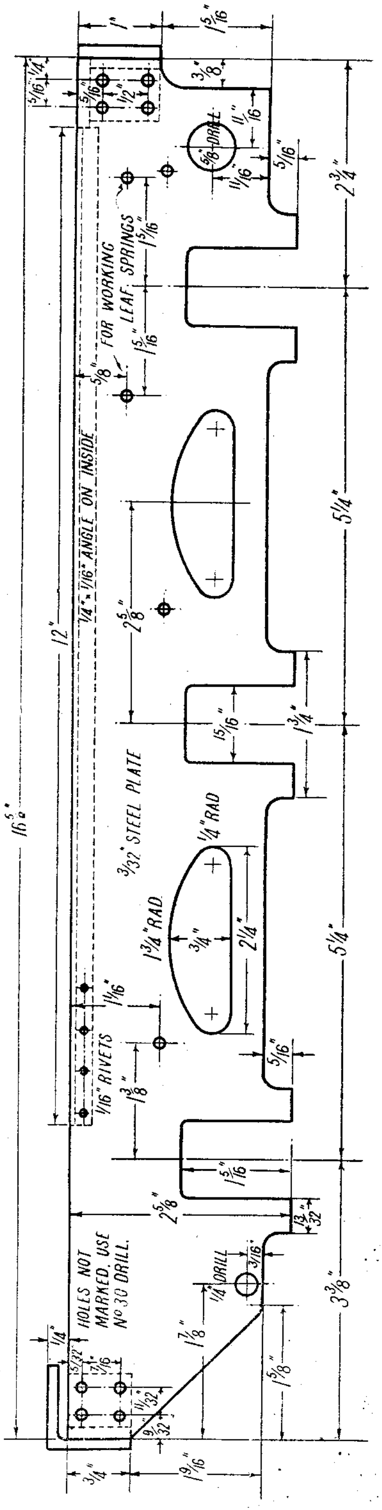
If the bufferbeam is to be brazed on, don't put any adornments on the frame until this has been done; but if you prefer to fix the buffer-beam to the frame by angles, which should, in any case, be used to fix the dragbeam, as this isn't slotted, then the pieces of angle for holding the tank, and the horncheeks, may all be fitted before the frames are erected.

Beams, and Frame Erection

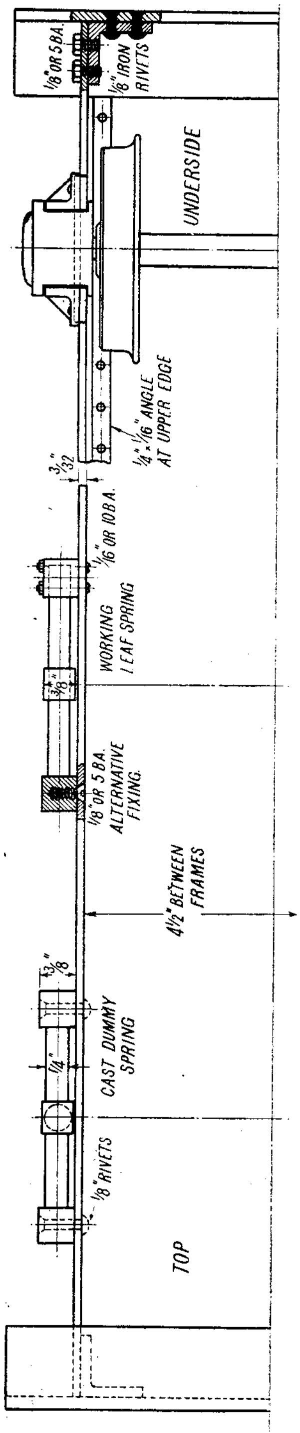
Both buffer and dragbeams are made from 6¼ in. lengths of 1 in



[T]ender for the 3½ in. gauge "Britannia"



Details of the tender frame



Half plan of tender frame assembly

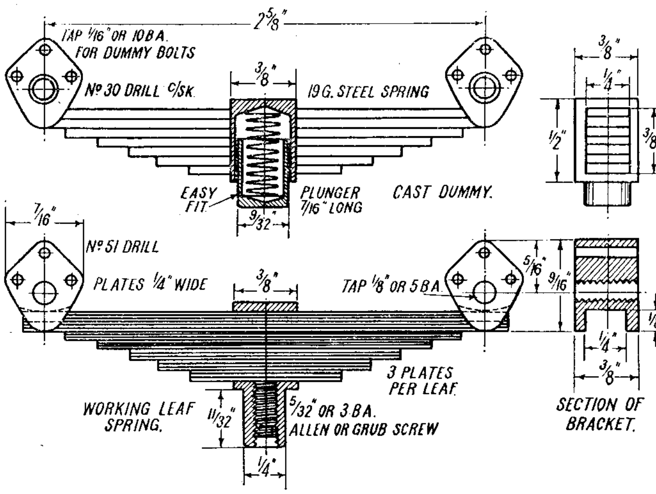
× $\frac{1}{8}$ in. steel angle. One face of each angle is cut away at the edges as shown; that for the bufferbeam is drilled and tapped for the stems of the buffer sockets, and a $\frac{1}{8}$ in. square hole is made in the middle for the drawbar. In the top, two slots, 3/32 in. wide and $\frac{7}{8}$ in. deep, are cut $4\frac{1}{2}$ in. apart for the frame plates. The dragbeam needs a slot 1 in. long and $\frac{3}{16}$ in. wide, cut in the face, for the coupling between engine and tender. The top of this one isn't slotted, as it stands $\frac{1}{4}$ in. above the top edge of the frames when erected. It merely carries a short plate extending to the front of the tank.

The way the frames are erected, is shown clearly in the half-plan view. The dragbeam is attached to the frames in exactly the same way as shown for the bufferbeam. Rivet two pieces of $\frac{3}{4}$ in. × $\frac{1}{8}$ in. angle, each $\frac{3}{4}$ in. long, to the inside of the beam, with the outer faces of the angles $4\frac{1}{2}$ in. apart. If the bufferbeam is also to be attached by angles as shown, rivet $\frac{7}{8}$ in. pieces of similar angle at the inner edges of the slots. When fitting the beams to the frames, lay the assembly on the lathe bed, or something equally flat and true; make sure that both are in full-length contact, and that the beams are square and level. Then hold firmly by aid of toolmakers' cramps, while drilling and tapping the holes for screws.

If the bufferbeam is to be brazed, attach dragbeam first, by pieces of angle as above, jamming the other ends of frames into the slots in the bufferbeam while this is being done, and making sure that the assembly is "all fair and square." To prevent the frames getting out of alignment while brazing the ends into the slots, put a distance-piece $4\frac{1}{2}$ in. wide in the middle, and secure with a big cramp over the outside. For jobs like this, I use a bit of large-diameter iron pipe, with the ends squared off in the lathe. How to braze the joints, has already been fully described, so I needn't waste time and space with needless repetition.

Horns and Axleboxes

Our approved advertisers will supply castings for the hornicheeks, and they should only need cleaning up with a file, and drilling for rivets, as shown. To please Inspector Meticulous and all his pals, I am specifying attachment by seven $\frac{1}{16}$ in. rivets, instead of the usual three or four larger ones; the smaller ones will do the job all right, but use iron or brass, not copper. Incidentally, beginners don't seem to realise that the little merchants are equal to



Tender springs

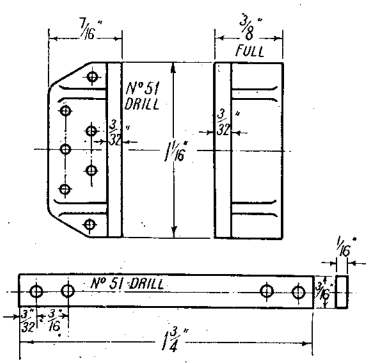
rivets 1 in. diameter on the full-sized engines ! Rivet the horncheeks flush with the openings in the tender frames, using a bit of bar $\frac{15}{16}$ in. wide, pushed into the opening, as a gauge, bringing the horncheeks close up to it. They should be $\frac{3}{16}$ in. above the bottom, to allow for the hornstays, which are merely $1\frac{3}{4}$ in. lengths of $\frac{3}{16}$ in. $\times$ $\frac{1}{16}$ in. steel strip, drilled as shown, and attached to the frames by four $\frac{1}{16}$-in. or 10-B.A. screws, after the axleboxes are erected.

As the axleboxes are practically the same as those described for the pony truck, I needn't go over the full rigmarole again. They will probably be cast in a stick, so if you are the lucky owner of a milling machine, the grooves at each side can be milled out at one fell swoop. If not, and your lathe cross-slide has only the usual short travel, saw the stick in half, and do three at a time, clamping the piece under the slide-rest tool-holder, and operating with a $\frac{1}{2}$-in. end-mill or slot-drill held in the three-jaw. Once more endeavouring to please our old nighthorse and his finicky backers—although I pull their legs unmercifully, I sometimes agree with them !—I've shown the correct axlebox cover, with inscription complete ; but I guess our friends in Argentina and what my old granny used to call other "furrin parts," will very discreetly scratch out the "Made in England" bit ! The boxes can be chucked in the four-jaw for facing the backs and drilling. The counterbore for the ball-bearing can be formed with a square-nosed tool set crosswise in the rest ; I used a glorified pin-drill when counterboring the ball-bearing axleboxes for my $2\frac{1}{2}$-in. gauge *Fernanda.* Note the recess behind the ball-bearing, which must be large enough in diameter, to clear the inner race ; this must be absolutely free. The ball-bearings should not be tight in the boxes, just a nice push fit. The bosses on the tender wheels prevent their coming out. Plain-bearing boxes merely need drilling ; there is no need to ream them, as the fit must be easy enough to allow the journals plenty of freedom when the axleboxes tilt as the engine runs over a bit of bad road, or through a crossing.

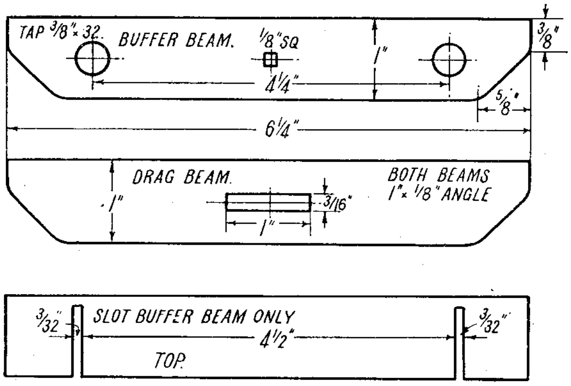
Springs

Both cast dummy and real working leaf springs are shown in the drawings, so take your choice. Cast dummies require very little doing to them ; drill the hoops to take the plungers, drill the cast-on brackets for rivets and dummy bolts, and clean up with a file if needed. The plungers or spring cups are easily made ; chuck a bit of $\frac{5}{16}$ in. round rod in three-jaw, turn to an easy sliding fit in the hole in hoop, face the end, centre, drill 7/32 in. for $\frac{3}{8}$ in. depth, and part off at $\frac{7}{16}$ in. from the end. Reverse in chuck, and round off the end. Springs are wound up from 19-gauge tinned steel wire, and should start to compress when a full $\frac{3}{16}$ in. of the plunger is showing below the hoop.

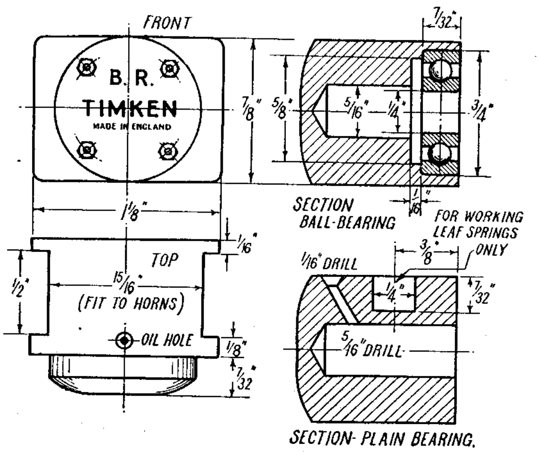
To erect the springs, clamp centrally over the axlebox opening in the frame, with the bottom of the hoop level with the top of the opening. Run a No. 30 drill through the holes in the brackets, right through the frame, and put in $\frac{1}{8}$-in. iron rivets, hammering the stems into the countersinks, and filing flush. Now, if you drill and tap three weeny holes, as shown in the face of each bracket, and put dummy hexagon-head screws in, Inspector Meticulous will be as joyful as a dog with two tails.



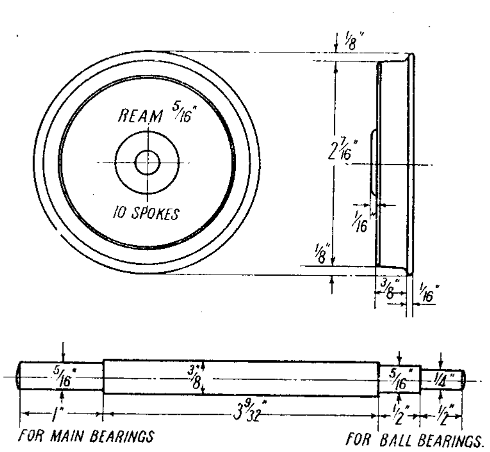
Horncheeks and stay



Buffer and drag beams



Axleboxes



Tender wheel and axle

I've already explained how to build up working leaf springs, in the description of the bogie and pony truck. Working springs for the tender are made in similar manner, but there is no need to punch the ends. They slide in grooves under the brackets. If our advertisers don't supply castings for the brackets, they can easily be milled, or sawn and filed from $\frac{1}{2}$ in. × $\frac{3}{8}$ in. bar as shown. The grooves at the bottom can be cut in the same way as the grooves in the axleboxes. Slightly round them off, as shown by the dotted lines. Fix the brackets to the frames by countersunk screws put through from the inside ; and to prevent the brackets shifting, or turning around, run a No. 51 drill through the holes in the brackets, carry on through frame, put $\frac{1}{16}$-in. or 10-B.A. screws through from the inside, with nuts outside, and when the worthy Inspector sees them, he will want to stand you a treat. *And* I'll say you've earned it !

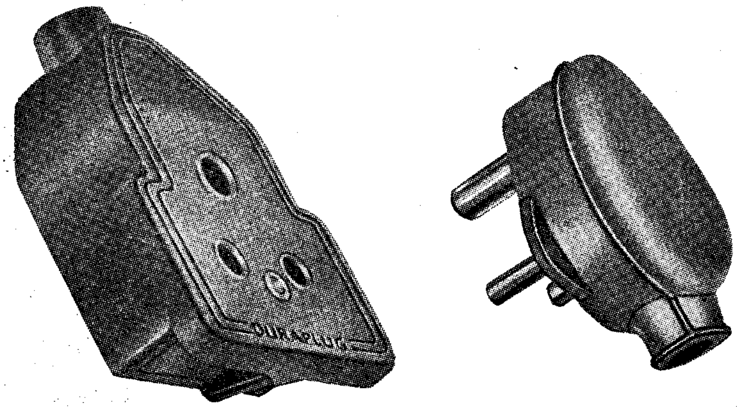
No fixing is required for the leaf springs. The lug under the hoop, which houses the clamp screw, fits into a recess drilled in the top of axlebox (shown in one of the sections) and the ends of the top leaves fit into the grooves in the underside of the brackets. When the hornstay is on, the spring cannot fall out, but is free to flex, as the ends can slide in the grooves, as in full size.

Wheels and Axles

As the wheels and axles are exactly the same as those on the pony truck (I mentioned at the time that it would save time later, if you made four pairs while on the job) we can once more skip the full detailing. The drawings give all particulars. To assemble and erect, put the axleboxes on the journals, and with the frames upside down on the bench, drop the axleboxes in place between the horncheeks, and put the hornstays on. When the assembly is turned right way up, it should run freely, the wheels being able to spin with the axleboxes in any position in the horns. If so, the completed frame will be all ready for the next step, fitting the tank and coal bunker.

RUBBER ELECTRICAL ACCESSORIES

Messrs. W. W. Haffenden, Richborough Rubber Works, Sandwich, Kent, have submitted to us samples of their new " Duraplug " electrical fittings, including a 5-amp 3-pin connecting socket, and a 5-amp 3-pin cable coupler. These are made entirely of rubber, with the exception of the actual metal conductors, and are, therefore, of high electrical insulating strength, impervious to moisture, and capable of withstanding mechanical impact or wear and tear. A special feature of the design is the tapered cable entry, which can be adapted to suit the size of cable used, and provides an hermetically-sealed joint. It is stated that in tests by the Electricity authorities, these fittings withstood 24 hours immersion in water without penetration, and also a parting pull well in excess of the 25 lb. recommended. Both devices will shortly be available in 15-amp size. They can be obtained from electrical dealers, or direct from the manufacturers at the above address.



The " Duraplug " 3-pin socket and plug

A Canadian "*TWIN-COUSIN*"

By J. I. Austen-Walton

IT was in the August 14th, 1952, issue of THE MODEL ENGINEER that I first introduced readers to the work of Mr. Bill Cooper. I showed, in the normal "Twin Sisters" article, a photograph of boiler parts he had made and assembled in a group, ready for riveting and brazing together. The remark I made at the time was that the workmanship was above the average, and examining the photographs reproduced here will, I feel, confirm that opinion for the work he has since carried out.

Mr. Cooper wrote to me, telling me that he hoped to produce a super-detailed locomotive, exactly on the lines of the "Twin Sister" being described and built in this country. That alone was enough to establish a bond between us, and his promise to send me some really informative shots of the chassis, both in parts and assembled, was eagerly awaited.

As readers will see, Mr. Cooper has proved himself to be one of the true model engineers who likes to do the job properly, and some of the detailed accounts of how he carried out certain parts of the work, make interesting reading. He tells me that the completed chassis and boiler took nine years to build.

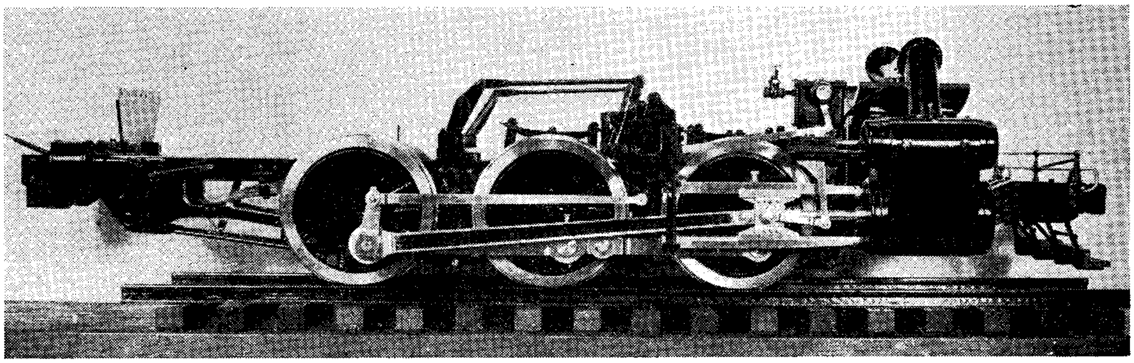
The Family Likeness

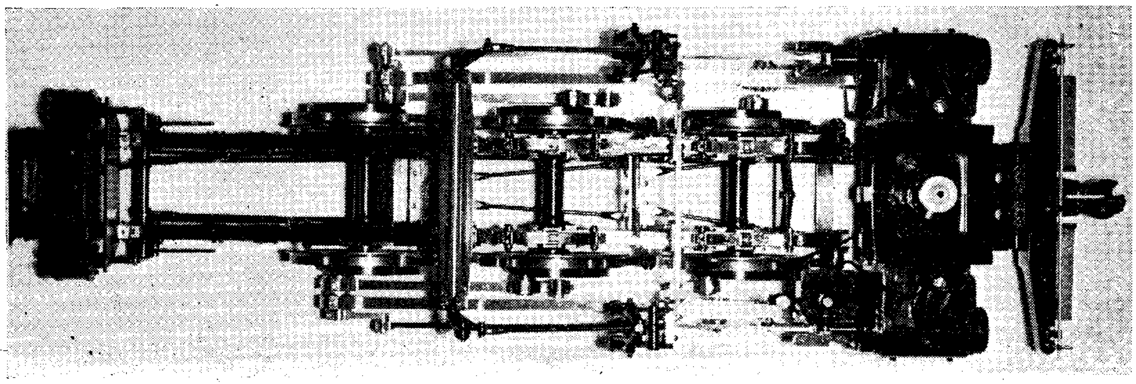
In its general proportions it will be seen that it bears a distinct resemblance to the L.M.S. 2F dock shunter. The wheel base is very short, for taking small-radius curves, but the connecting-rod runs back to what would be our trailing coupled wheels, this being common practice in Canada and the U.S.A.

The scale used was 1 in. and the gauge 4¾ in., a point that will interest some of our north of England folk, who still think the true scale gauge is the most sensible.

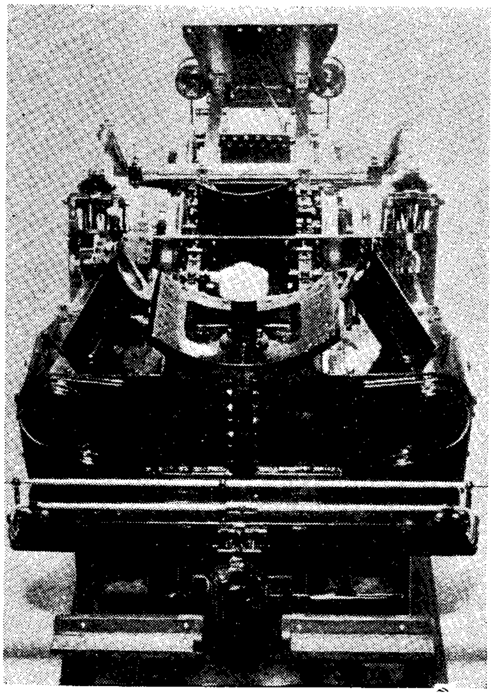
The locomotive, to give it a correct title, is known as the C.N.R. 0-6-0 Switcher, and the following are some of the details of its construction. The frames were cut from ½ in. × 3 in. wide normalised steel with all the openings ground out in a drill press, while held in a compound slide vice. The wheels, for which he made his own pattern, were cast in Meehanite, and he admitted that the pattern-making jobs were the only ones that became really tedious because of the long time spent on them. The excellent castings made up for it all, and the results show clearly in the close-up photographs.

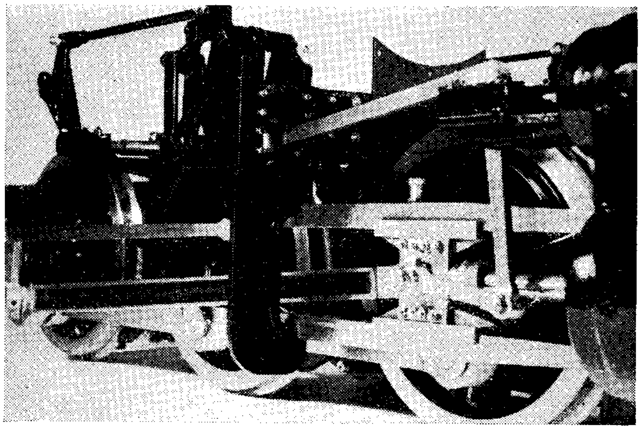
The axles are made from 1 in. diameter "drill rod," which we may assume is a material equivalent to our silver-steel; they had keyways milled out at 90 deg. to take ⅛ in. square keys.





Above—A side view of the chassis *Plan view of the chassis*





Three-quarter view, showing motion plate and valve spindle guide bracket

Left—Front view of the chassis

Doing the axle job this way made it absolutely necessary to get the corresponding keyways in the wheel seats in exactly the right positions, and it was only when he discovered how very difficult it was to obtain such accuracy in practice that he devised a further correcting device of both novel and effective design; of this I shall have more to say later.

Mr. Cooper discarded the idea of making roller-bearings on the lines I described, and fitted in their place a full set of Timken taper roller-bearings, each bearing having a system of dust-excluding shields on both sides.

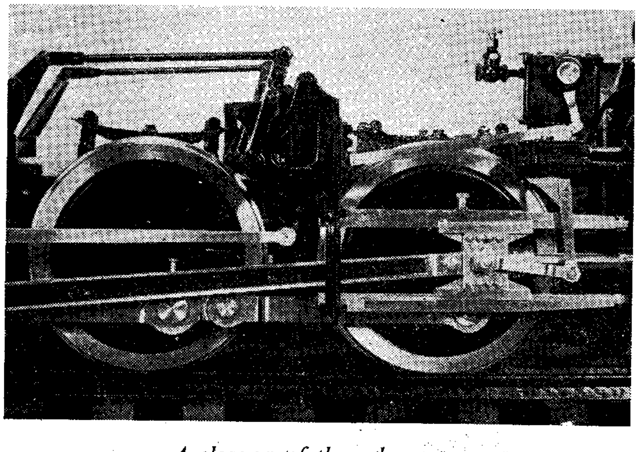
The springs are working leaf type, equalised and augmented by coil springs which are readily removable if not required later, and the brakes, fitted with one steam brake cylinder for each side, are fully equalised.

Cast-bronze was the material chosen for the cylinders, and rendered even more proof against wear by the fitting of manganese-bronze liners. The bore is 2 in. and the stroke $2\frac{1}{2}$ in.

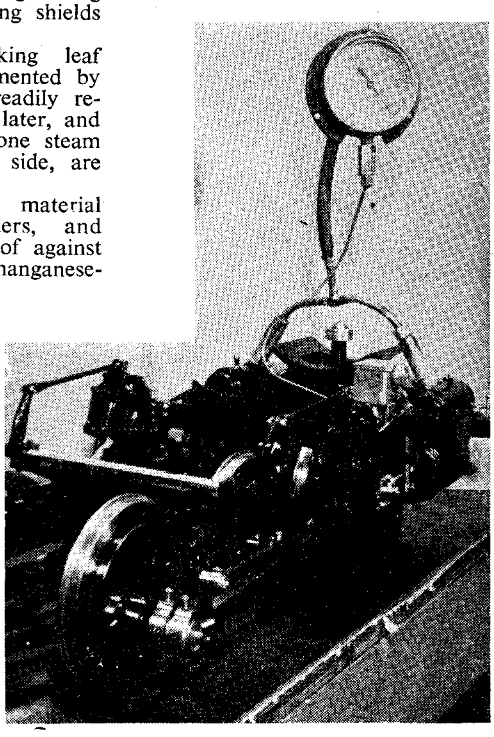
Stainless-steel piston valves are used, $\frac{7}{8}$ in. diameter, each fitted with four correctly formed and stepped piston-rings.

All Stainless-steel

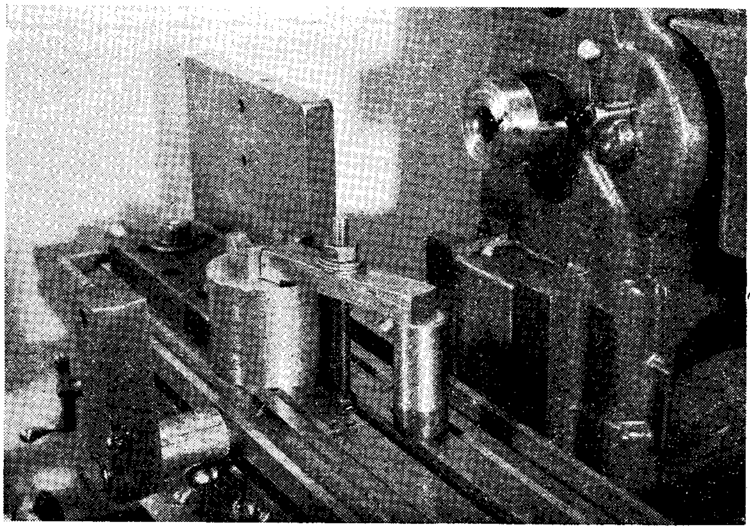
When it came to the making of such parts as the side-rods, eccentric-rods, guide-bars, bolts, washers and pins, some 18-8F. stainless-steel was obtained, and all these parts



A close-up of the valve gear



A lubricator test—250 lb. held on the clock



The milling machine set up for wheel quartering

were machined from the solid. His verdict was that, provided the cutters were kept sharp, the various jobs presented no problems at all. He describes a subsequent finishing operation for such things as side-rods and eccentric-rods. By fitting spindles of various diameters with Alumide paper, and running these at *low* speeds in a drill press with oil as a lubricant, he was able to reach every part of the work, remove all traces of tool marks, and finish up with a smooth satin surface.

The valve-gear, as will be seen in the accompanying views, is long-lap Baker gear. It is the double-yoke type with bronze bushings for all the pins. This gives ⅝ in. travel in full gear.

Altogether Mr. Cooper made three sets of the Baker gear. The first set, made from drawings supplied by the Pilloid Company, gave the standard travel scaled down, and was, therefore, not quite satisfactory. He made a second set with a longer travel, and finally he produced a long-travel, long-lap set that gave satisfaction when the chassis was tried out on air.

The lubricator, based on "L.B.S.C.'s" design is the twin-cylinder type, and fitted with "Neoprene" faced disc valves. It was tested to 460 lb., and one of the photographs shows a pressure of 250 lb. being maintained on a smaller gauge while the photograph was being taken.

The completed chassis weighs 106 lb., and Mr. Cooper tells me he is quite glad when someone helps him to carry it around.

Wheel Quartering

It was in this department that the trouble really started, and I shall quote Mr. Cooper's own comments on the trouble he met, and the steps he took to get over it, he says :—

"Originally, the wheels were quartered on the axles carefully with the aid of a dial indicator; but when squeezing them home in an arbor press, they always seemed to move very slightly, and it was felt that this method could be improved upon. The milling machine was then set up similar to a lathe quartering machine in full size practice, and all pin centres were bound to come out alike.

"The actual steps taken, worked out in the numerical order, as under:

"1. All R.H. crank-pins finished to size. All L.H. main crank-pins finished to size. All L.H. leading crank-pins left oversize by 0.010 in. All L.H. coupled crank-pins left oversize by 0.010 in.

"2. Wheels then pressed on carefully with aid of dial indicator.

"3. The 'Vee' blocks and clamp plate were then set up square and parallel on the miller table with an indicator.

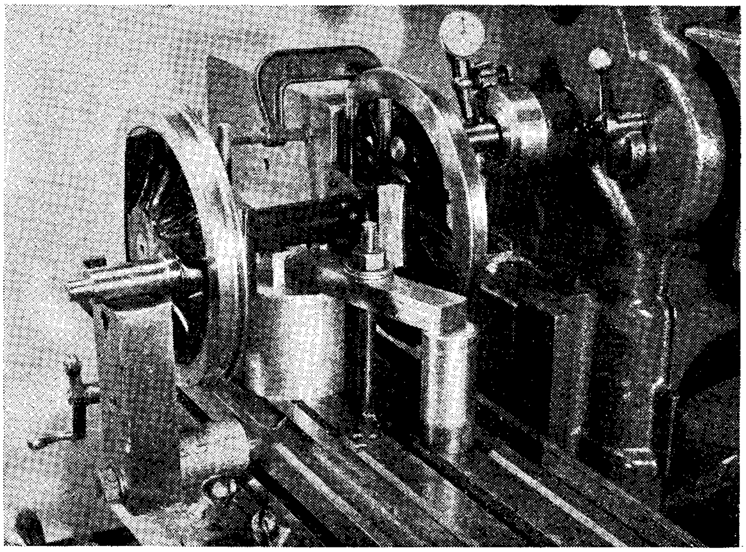
"4. Maindriver placed in 'Vee' blocks, and table set so that the dial indicator showed no running out. Table then locked tight.

"5. Coupled wheels now placed in 'Vee' blocks and carefully fed in against very sharp tool in hollow cutter. This reduced the plus 0.010 in. pin to the finished size required.

"6. Leading wheels treated as for No. 5."

Due to the difference in the diameters of the crank-pins before the use of the hollow cutter operation, a removable bushing was placed on the finished leading and coupled crank-pins, so that the centre was maintained on the location block.

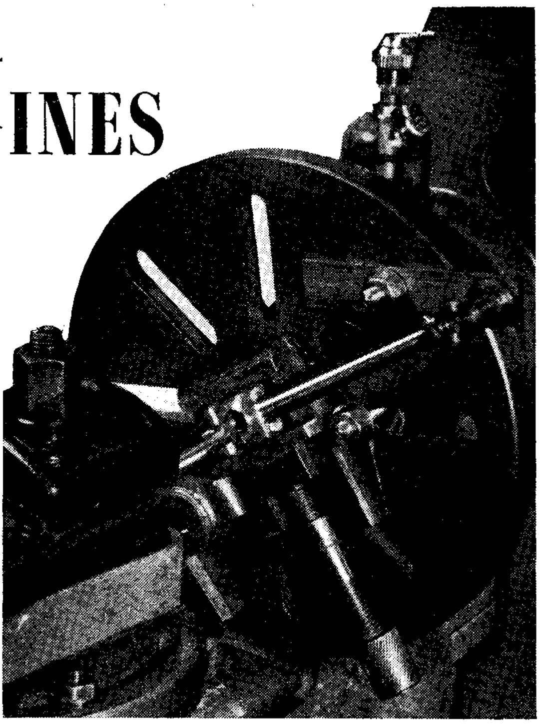
(*Continued on page* 265)



Machining and checking crank-pin setting and diameter with special rig attached to milling machine

MORE UTILITY STEAM ENGINES

By Edgar T. Westbury



The connecting-rod held by the big-end in a small vice, and located by a pin at the little-end, for boring the crankhead bearing

THE split crankhead bearing may be made either from a casting or from solid bronze, and in view of the difficulty of getting really accurate castings in so small a size, the latter is probably easier and more satisfactory. I used a chunk of metal cut from an old casting found in the scrapbox, which was first machined all over to make two rectangular pieces, $\frac{1}{4}$ in. by $\frac{1}{2}$ in. by $\frac{13}{16}$ in. long, the latter two dimensions being left on the full side for finishing, but care was taken to obtain geometrical accuracy, in other words, to get them parallel and square on all surfaces.

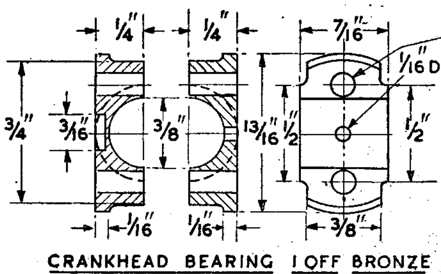
One of the pieces was held across the jaws of the four-jaw chuck and recessed to fit the spigot on the foot of the connecting rod; note that this recess must be kept shallow to avoid the risk of going right through to the bearing surface, but it is important that the main face of the half-bearing should bed properly against the foot of the rod. The positions of the bolt holes should be accurately marked out on this face, and the holes drilled; if a drilling spindle for the lathe is available, it may be used with advantage to ensure positively that the holes are symmetrical to the bearing centre and also exactly on the centre line.

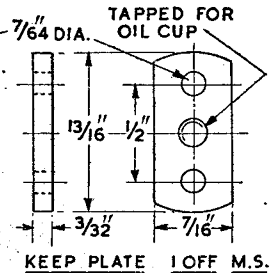
As the bolts have to serve as dowels to register the two bearing brasses, they should be made a close fit for the 6-B.A. bolts, and a 7/64-in. drill is just about correct for this if it is "piloted" by the next smaller size drill. The second half-bearing can also be drilled by clamping it in register with the first, which is used as a jig; but knowing the wandering propensities of small drills, the operation should be carefully watched if it is done in the ordinary way. The use of the drilling spindle in the lathe, with the cross-slide setting and indexing exactly the same as for the first piece, is much to be preferred. Some constructors may prefer to sweat the two pieces together while machining, which is quite a sound policy, but not really necessary in this case.

At this stage, it is advisable to make the keep-plate, to the same breadth and height dimensions as the half-brasses; it may be cut from a piece of 3/32 in. thick bright mild steel, and should not need machining on the faces if the surfaces are true. I had no material of the right thickness available, so I chucked a piece of $\frac{7}{8}$-in. × $\frac{1}{2}$-in. steel bar, faced the end, drilled the holes with the drilling spindle as before, and parted it off. This was just as easy as any other method in the circumstances, but jig drilling from the mating parts is quite satisfactory. Do not drill the centre hole for the oil cup at this stage.

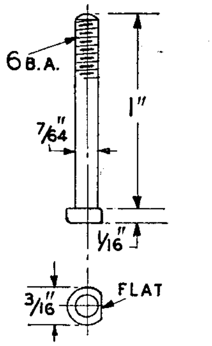
The bolt holes in the foot of the rod can also be jigged from the inner half-bearing, care being taken to see that the edges of the latter are aligned with those of the foot. All these operations are simple and straightforward, but it is surprising

Continued from page 204, *August* 13, 1953.



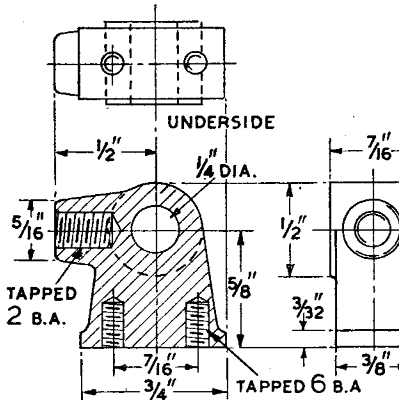


CRANKHEAD BEARING 1 OFF BRONZE KEEP PLATE 1 OFF M.S.

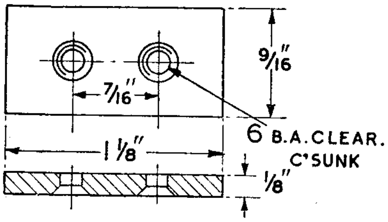


CRANKHEAD BOLT 2 OFF M.S.

how easy it is to go wrong, and one often finds that the assembly goes together out of line for no readily explainable reason; so do not relax or neglect precautions to ensure accuracy, as this vitally affects the success of the engine. It will be seen that the crankhead bolts have round heads, with a flat filed on one side to clear the fillet at the foot of the rod; as already mentioned, they should fit the holes closely, even to the extent of a light tapping fit. I made mine from some ex-aircraft bolts obtained from Ken Whiston, simply by turning down the heads and filing the flats. The assembly



CROSSHEAD 1 OFF BRONZE



SLIPPER PLATE 1 OFF M.S.

should now be bolted to the rod for further machining *in situ*.

It will be quite obvious that the bore of the crankhead bearing must be exactly parallel, in both planes, with that of the little-end eyes; so the method of machining this bearing was arranged to ensure positively that it should be so. The centre position of the bearing was first marked out and centre-punched on one face of the bearing, to coincide exactly with the division of the half-brasses, and in line with the centre of the connecting-rod.

A simple jig was now made to locate the fork end of the rod; this consisted of a turned stub mandrel $\frac{1}{4}$ in. diameter, mounted squarely in a flat plate which could be clamped to the faceplate of the lathe. Owing to the length of the connecting rod, it is quite likely that constructors may find that it overhangs the edge of the faceplate, but provided that the mounting plate of the mandrel is extended to suit, this will not matter. It is, of course, essential that the lathe should be capable of swinging the radius over the fork, otherwise a different method of carrying out the operation must be employed.

The crankhead end of the assembly was held in a small machine vice mounted in the centre of the faceplate, and with the fork end of the rod fitted over the stub mandrel, the entire assembly was adjusted so as to centre the marked position for the bearing axis. All this, of course, must be done with the mounting bolts, and also the vice-jaws, little more than finger-tight, so that nothing is "sprung" or forced in setting up. Having set it up accurately and tightened the fixings, the bearing, including the edges of the foot and the keep-plate, is faced, after which it is centre-drilled, pilot drilled, and bored out $\frac{3}{8}$ in. diameter to fit the crankpin. There is no harm done in boring it a "thou." or two oversize, as some fitting adjustment is sure to be called for, and a bearing of this type should always be fitted "easy on the horns," to use a common marine engineering expression. A slight rounding-out or chamfering of the mouth of the bore is necessary to clear the fillet of the crankpin; this is often left to be done with the scraper when bedding-in the brasses, but it saves time to do at least part of it by machining. The old practice used to be to bed-in to the fillets as meticulously as to the rest of the bearing surface, but nowadays it is customary merely to ensure that there is clearance to avoid risk of "riding" on the fillets; all too often, I am afraid, time for fitting bearings is grudged, with the result that "silky" running is the exception rather than the rule.

The reverse side of the bearing can be dealt with by turning the assembly over; a little re-setting will probably be found necessary to get the bore exactly central again, but high precision is not called for, as the object is simply to face the end of the bearing square and relieve the outer surface, including the edges of the connecting-rod foot and the keep-plate. The width of the bearing should be adjusted so that it will just fit neatly between the crank webs with no perceptible end play.

For the final operation on this assembly, it is necessary to set it up on its longitudinal axis for machining the concentric arcs over the outside of the bearing. The use of a three-point steady near the foot of the rod will help in setting up; the fork end, with the filling piece (mentioned in the July 30th issue) fitted, being held in the four-jaw chuck, with soft metal pads to protect the machined faces. A small centre-drill is then used to form a locating centre in the keep-plate, enabling the tailstock centre to be used to support the assembly at this end. Turn the edges of the bearing to $\frac{13}{16}$ in. diameter, and relieve the centre portion to the extent of about 1/32 in. or so, as shown on the drawing.

Crosshead

The type of crosshead employed on this engine is rather unusual, and it may be mentioned that the one shown on the drawings differs in some respects from that on the first engine constructed, as seen in the photographs; this was machined from solid steel, with an inserted bronze bush for the wrist-pin, but the component as shown here is easier to make, and equally satisfactory. It is made in two parts, and this facilitates dimensional adjustments; the slipper plate may with advantage be made and fitted first, then attached to the crosshead itself afterwards.

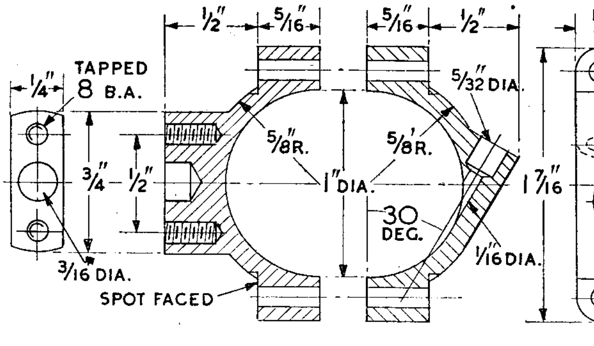
A piece of $\frac{1}{8}$ in. bright mild-steel plate is machined or filed and scraped to slide smoothly and freely between the keeps incorporated in the cylinder support bracket. Adjustment of up-and-down clearance here is possible by either scraping or shimming up the underside of the bracket, but it is best to avoid the necessity for this if possible. The main portion of the crosshead is now made from a casting or a solid piece of bronze, and may be bored and faced on the two sides, after which it is clamped to an angle-plate for machining the base surface, exactly parallel with the axis of the bore, and at a distance of $\frac{5}{8}$ in. from it.

The holes for the screws fixing the slipper plate to the crosshead are now drilled and tapped, care being taken to ensure that the sides of the plate are square with the bearing bore; when the screws are fitted, make certain that the heads are

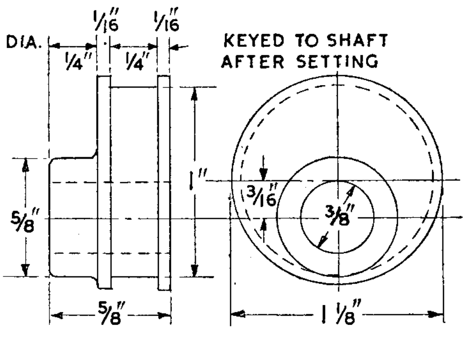
sunk sufficiently to avoid risk of fouling the slideway. Stand the assembly on a surface plate, with a ¼-in. mandrel through the bore, and check the height of this at each end; if necessary, correct any error by scraping the base of the bronze crosshead. Last but not least important of the operations on this component is the drilling and tapping of the hole to take the front end of the piston-rod, and this demands more than ordinary care, as it must be correct all ways.

In the case of the wrist-pin bearing, geometrical accuracy is everything; a few thousandths of an inch discrepancy in height from the base of the slipper plate makes no difference whatever to the mechanical working of the engine. With the location of the piston-rod, however, the height must exactly coincide with that of the gland centre, or binding will occur unless excessive or sloppy clearances are allowed everywhere. A common method of ensuring alignment in this respect is to place the crosshead in its slideway, as close as possible to the mouth of the gland, and use the latter as a jig, by drilling from the open end of the cylinder. In the case of this engine, however, it is necessary to drill an undersize hole, for tapping the crosshead, so that the hole can only be "spotted" by the above method, unless a jig bush is used in the gland. However, I am always a little suspicious of jigging methods in an operation where alignment is so important, and I prefer to adopt more positive measures to ensure that the hole goes exactly in the right direction after it has been initially located.

For this reason I advocate that the crosshead should be mounted on the miniature angle-plate on the faceplate, with the mandrel again inserted in the wrist-pin bearing, and its distance from the faceplate checked at each end. The angle-plate is then moved bodily to centre the marked location of the hole, after which it is centre-drilled, followed by drilling and tapping to 2 B.A. While this method will take longer than that previously described, it has the inherent advantage as I have so often pointed out, of keeping a definite check on accuracy. When the work is set up in the lathe and drilled with a stationary drill, the slightest deviation from accuracy is immediately detected by the wobble of the drill. It sometimes happens that the drill does not behave as it should—it may not follow the centre-drill truly, or it may run into a porous patch of metal—in which case steps can be taken to correct this, by drilling well undersize and opening out with a small boring tool. Now it will be obvious that the same tendency to inaccuracy occurs when the work is stationary and the drill rotates, but in this case it is *not* detected until it is too late to do anything about it. Elementary logic —or ancient history ?—of course ; but it will bear repeating for the benefit of those who have not realised it yet !



ECCENTRIC STRAP 1 OFF BRONZE



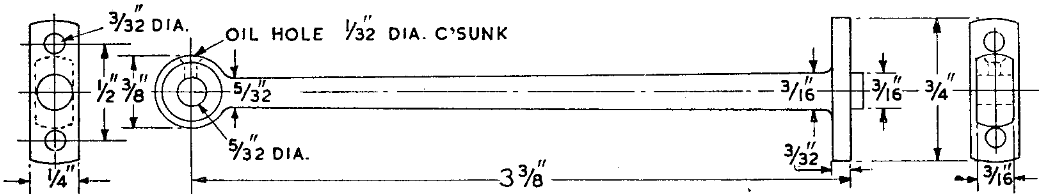
ECCENTRIC SHEAVE 1 OFF M.S.

Eccentric Sheave

This is machined from mild-steel, though it could be made from cast-iron if desired; a separate casting would not be quite so easy to handle, however, as a piece of bar stock, which should be true and parallel on the outside, to conform with the methods I am about to describe. It should be observed that if the feed pump is to be fitted to the engine, two identical eccentrics will be required, and these may well be dealt with at one setting, as this will save a good deal of time. A piece of material about 3 in. long should be used, and it does not matter if it cleans up slightly under the specified size (1⅛ in.) as this dimension is not important.

The first operation consists of chucking the bar to run as true as possible over the outside, facing the end, and turning the groove to form the journal. It may be found desirable to support the end of the bar from the tailstock, but if a centre is drilled, allowance should be made in the length for machining it away afterwards, unless one is content to make this the flat side of the sheave, so that the centre-drilling—which comes right on the edge of the bore—is hidden against the main bearing. The position of the journal groove, of course, must be arranged to suit. If two eccentric sheaves are required, allowance must be made for the metal removed in parting or sawing off; the two grooves may then be turned at one setting.

It is now necessary to set the bar over eccentrically for boring and turning the boss. I use the Keats vee angle-plate for nearly all operations of this nature, but one could use an ordinary vee-block of fairly large size, if means are available for clamping the bar firmly in the vee, and also mounting the block on the faceplate. The centre of the bore is marked out at $\frac{3}{16}$ in. from the original centre, and the assembly is set up to centre this point as accurately as possible, after which it can be centre-drilled, pilot-drilled and bored to ⅜ in. diameter, a little on the tight side for the shaft. A bore long enough to pass through both sheaves may be produced at one operation, but it will probably be found more convenient, and also conducive to accuracy, to do one at a time, finishing the first and parting or sawing it off (parting may be somewhat difficult because



ECCENTRIC ROD 1 OFF M.S.

of the intermittent cut and the length of blade necessary) before tackling the second. The flat face may be cleaned up by mounting the sheave on a mandrel.

It may be mentioned that several modifications of the valve-gear on this engine are possible, such as reversing gear of the single-eccentric type, like the Marshall or Hackworth gear. Stephenson link motion, of course, requires two eccentric sheaves, which would have to be made narrower than those shown, and the same applies to Meyer or similar expansion gears. Engines intended for stationary work do not require reversing gear, unless they have some special duty to perform, such as hauling or hoisting; but in the interests of steam economy, they have often been fitted with expansion gears or link governing. However, the prototype of this engine had simple single-eccentric valve-gear. I mention these points because many constructors like to indulge their fancy in mutations of a standard design, and it is just as well to point out what deviations or embellishments are permissible.

Eccentric Strap

A casting would be best for this component, as it would save a good deal of work, but I made the straps for this engine from a piece of scrap bronze, which was shaped by sawing and drilling to the outline required, leaving allowance for splitting and machining the bore, the thickness also being sufficient to allow facing both sides. On the outer side, the projection which ultimately becomes the lug for the oil cup was left long, for reasons which will be seen later. The bolt holes were marked out, drilled, and spot-faced, and the strap was then split with a small slitting saw in the lathe, after which the faces were trued up by mounting the halves separately on the miniature angle-plate. They were then bolted together and set up in the four-jaw chuck for boring and facing one side; the other was dealt with by mounting the strap on a shouldered stub mandrel, and the width adjusted to fit the groove of the sheave without side play.

Once again the strap was mounted on the angle-plate, complete this time, and the inner side faced and recessed to fit the foot of the eccentric rod. While set up for this operation, the tapping holes can be drilled with the aid of the drilling spindle, though it is best to arrange the sequence of operations so that the foot of the rod can be dealt with at the same setting.

Eccentric-rod

This is made from mild-steel bar, $\frac{3}{4}$ in. diameter, being large enough if it is set up truly for centre-drilling both ends, and the operations on it are very similar to those on the connecting-rod, except that the little-end is in the form of a ball, $\frac{3}{8}$ in. diameter, instead of a fork. It is advisable to shape this while the bar is held in the chuck for centring the end, and the use of a spherical turning tool, such as the simple radial lever type as described in connection with the machining of the "M.E." swivelling vice, will enable this to be done accurately; however, it can be finished to shape with a hand turning tool, using a radius gauge to check the shape, accurately enough for the purpose if due care is taken.

The rest of the turning on this part is quite straightforward; the tapered shank may be slightly bellied, as described for the connecting-rod, if desired. To drill the bolt-holes in the foot, using the drilling spindle, the rod may be held by the shank in the three-jaw chuck, as close to the foot as possible, and with a slip of copper or aluminium foil round it to prevent marking.

After attaching the strap, which should bed firmly on the foot of the rod, the latter may again be held in the chuck, and the outer end lightly centre-drilled so that it can be supported by the back centre. A skim is now taken over the outer edge of the strap, also the mounting boss, so as to register the latter with the foot of the rod. The sides of the foot are cut away, flush with the sides of the strap.

The drilling of the ball knuckle may be described as the reverse of the operation on the big-end of the connecting-rod, as the eccentric strap is used, with its flat side against the faceplate, to provide angular location, and the ball end is located by means of a small vice, or similar clamping device, in the centre of the faceplate. The hole is centred, drilled and reamed 5/32 in. diameter, and the sides of the boss symmetrically faced to $\frac{3}{16}$ in. wide.

(To be continued)

A CANADIAN "TWIN-COUSIN"

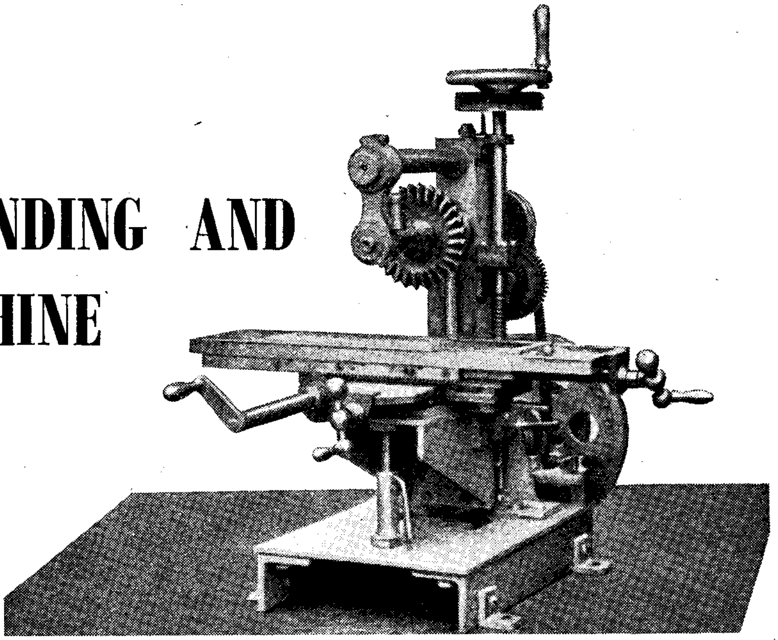
(Continued from page 261)

This method gave an *absolutely true quartering* on all the pins, and while it seemed to involve a great deal of time, the *actual* time was not so great. The recorded time for the whole job worked out at three hours, and he had the certain knowledge that no shadow of doubt was left hanging about to keep him awake at night. Mr. Cooper estimates that some twenty hours were wasted previously, when trying to do the job on the hit-or-miss principle. Later, when the coupling-rods were set up on the wheels, the absence of tight spots paid a final dividend in satisfaction.

Since these photographs were taken, the boiler has been completed, and we shall look forward to seeing the engine in its final form. The only report so far made in the performance department, is a compressed air run on the chassis alone. On a pressure of 15 lb. she ran with perfectly even beats, forwards and backwards, at all points of cut-off.

It is felt that all readers will congratulate Mr. Cooper on a remarkably fine locomotive, carried out in a thoroughly masterly style.

HORIZONTAL SURFACE GRINDING AND MILLING MACHINE



By R. Hamilton

IT will be generally accepted, I think, that a machine combining the functions of milling and surface grinding, would be very useful in the small workshop and enable the amateur to impart a precision and finish to items, otherwise difficult to achieve. With such a consideration in mind, I commenced, about a year ago, the construction of such a machine and now have it in satisfactory use.

The following notes and drawings may interest readers who wish to add to their equipment but find the costs of purchasing too heavy.

No castings are employed ; the entire machine is fabricated in steel, picked from scrap. The only parts purchased were pulleys, two Myford gear wheels (30 and 60 teeth), two bearing blocks and elevating screw hand-wheel. My outlay was under £6, including the cost of welding.

All machining was done on a M.L.7 lathe, excepting the shaping of column and surface grinding of parts. Access to a shaper and grinder was provided by a friend. As most readers require no instruction from me in the general aspects of setting-up, turning, etc., I shall not attempt to elaborate.

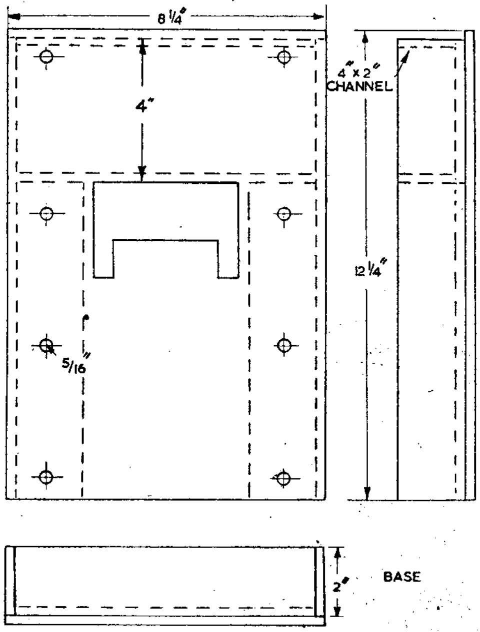
For convenience, the construction is set out under the following heads : 1. Base and column ; 2. Knee, cross traverse and table ; 3. Spindle, overarm and bracket, arbors and elevating screw ; 4. Pulley arrangement, backgear, countershaft, also sundry items and comments.

The drawings are self-explanatory; a few parts, such as handles, rack, cross traverse feedscrew, etc., being omitted. Potential constructors will suit themselves as to dimensions of parts ; mine were conditioned by the machining limits of the M.L.7. A good deal of hacksawing is involved, but this can be spread over.

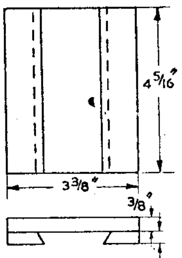
Base and Column

The base is a ½ in. thick plate screwed from the underside to heavy angle iron sides, to which holding down lugs are attached. Below the column is strongly reinforced by a heavy channel iron piece which is welded to platform and sides. The horizontal webs of angle iron, it will be noted, are sufficiently cut away to allow flush fitting of channel piece. The opening in the platform allows the knee to sink somewhat below the sheer limit, an advantage when the awkward job comes along.

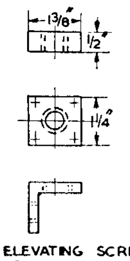
The column (in my case) was shaped from a solid steel block I had handy, and surface ground all over. As the column is bound to present difficulty to most constructors, I would mention in passing, the feasability of a fabricated hollow column made from two lengths of channel iron locked by two heavy plates, the front one of which could have the vees machined on it. The width of such a column would allow the fitting of taper roller bearings. Drilling, boring and tapping were routine jobs. Holes for bracket screws were marked off from completed brackets. Note that the spindle hole is opened up



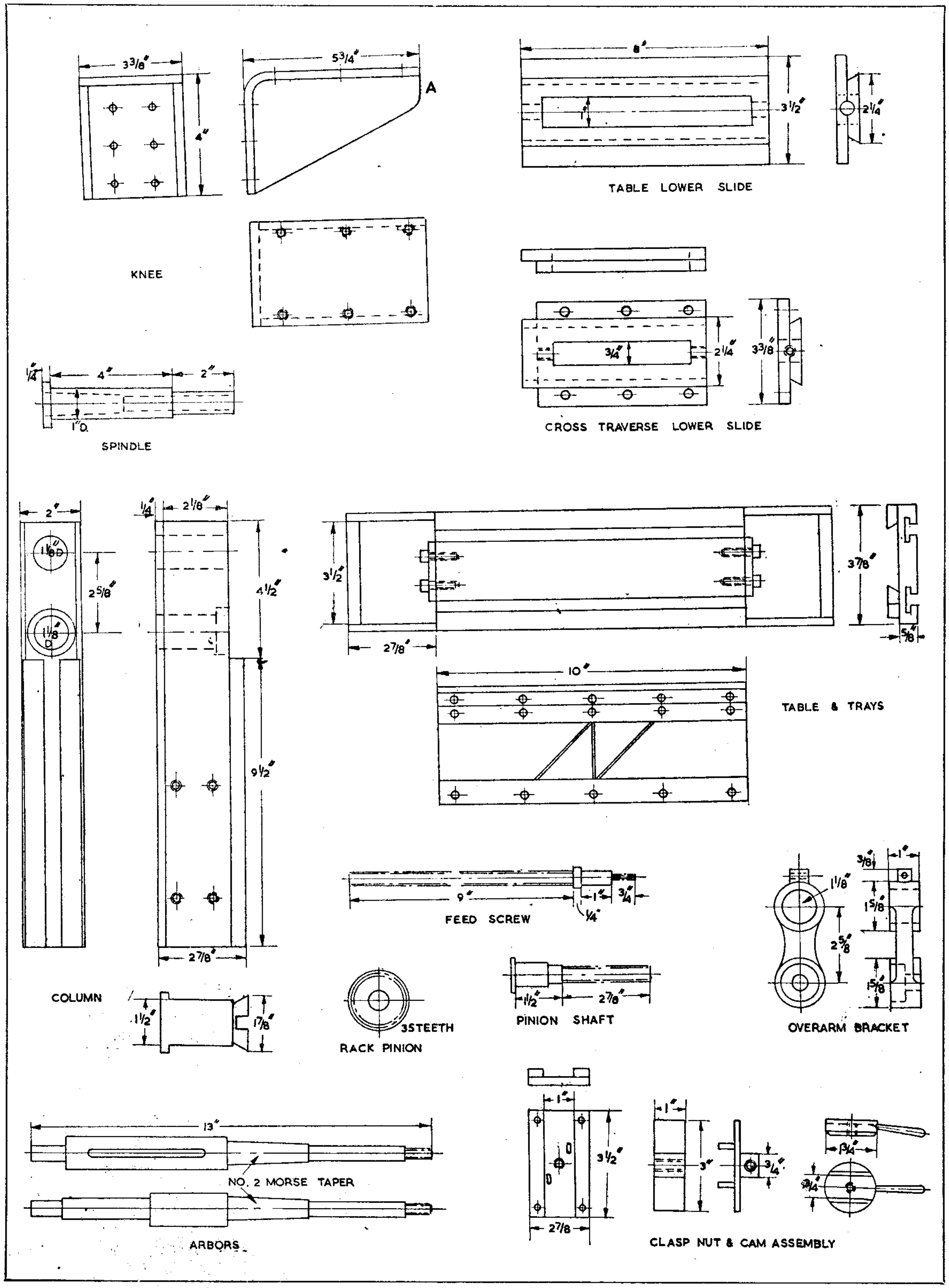
BASE

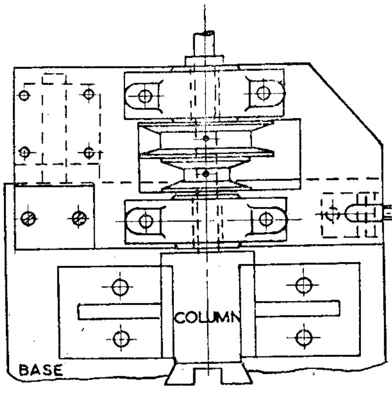


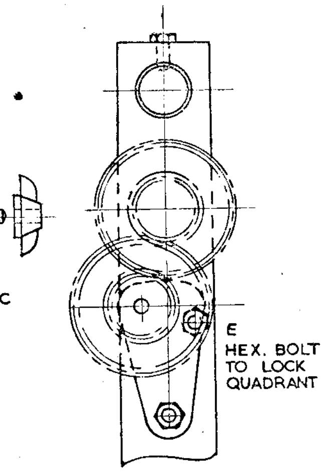
VERTICAL SLIDE

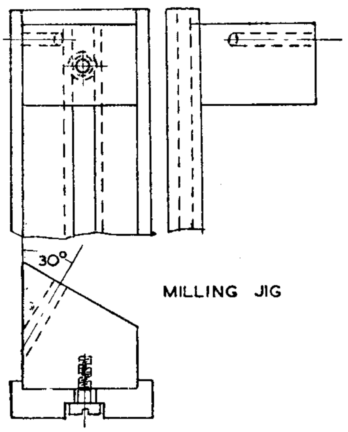


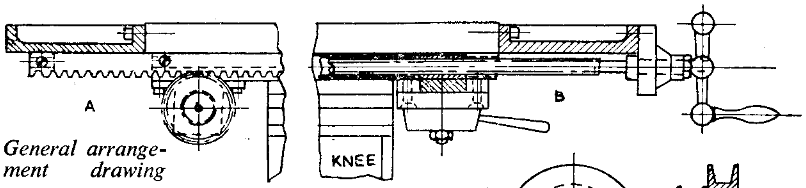
ELEVATING SCREW BRACKET & BLOCK


KNEE
3 3/8"
4"
5 3/4"
A
TABLE LOWER SLIDE
8"
1"
3 1/2"
2 1/4"
SPINDLE
1/4"
4"
2"
1" D.
CROSS TRAVERSE LOWER SLIDE
3/4"
2 1/4"
3 3/8"
COLUMN
2"
1 1/8" D
2 5/8"
1/4"
2 1/8"
4 1/2"
9 1/2"
2 7/8"
TABLE & TRAYS
3 1/2"
3 7/8"
5/8"
10"
FEED SCREW
9"
1"
3/4"
1/4"
RACK PINION
35 TEETH
1 1/2"
1 7/8"
PINION SHAFT
2 7/8"
OVERARM BRACKET
3/8"
1"
1 1/8"
1 5/8"
2 5/8"
ARBORS
13"
NO. 2 MORSE TAPER
CLASP NUT & CAM ASSEMBLY
3 1/2"
3"
3/4"
1 3/4"

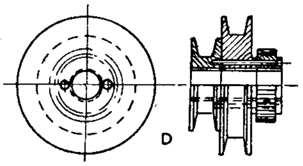








General arrangement drawing



to accommodate a ball thrust.

The two supporting brackets were bent (in a blacksmith's bending machine) from $\frac{1}{4}$ in. thick flat plate and machined webs welded in place. A little filing and scraping secured good seating on both faces, which is essential to avoid strain on base and column. Countersunk screws had to be used in two holes of the right-hand bracket to allow clearance for elevating feedscrew block.

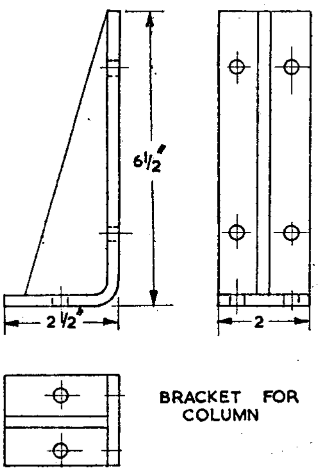
Knee, Cross-traverse and Table

The knee was also bent from flat and machined sides welded on. It was set up on the lathe table and edge marked *A* milled. Then the horizontal platform was placed on the table with the *A* edge lined up parallel with the table rear edge, and the vertical platform machined by feeding it across a tool suitably offset in chuck. This face was next bolted to an angle-plate, set parallel with lathe axis (the *A* edge providing vertical alignment check) and the long face likewise machined. The operator will find this quite a ticklish job ; I fitted the tool in a block which was gripped by chuck jaws.

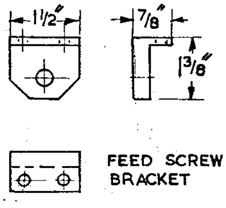
All slides are built up, the plates and strips ($\frac{5}{16}$ in. finished thickness), being first ground on inner faces before countersunk riveting them together, to prevent warping, then ground on outer faces. Uniformity of vee-angles on plates and strips was obtained as follows: A jig (as shown) was made and plates screwed down thereon and end milled. The jig was lined up with the table front edge, packed up as required, and the angle blocks moved apart to suit varying lengths. The holes in plates were plotted, as far as possible, to be used in assembly. Strips were actually cut off from plates, after milling. Additional cross-slide traverse was obtained, when required, by insertion of accurate distance pieces between cross-slide face and bracket) and cuts made in stages without disturbing the workpiece.

The completed cross traverse and vertical-slides were secured to the knee by cap screws.

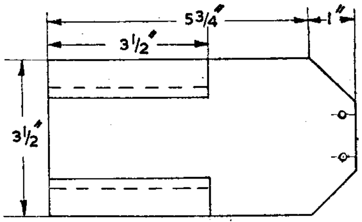
The table was quite a job, due to its size. After facing both sides and end milling to square, it was clamped to a long, broad and heavy angle-iron which was bolted to the lathe table, the whole assembly overhanging the front of the slide with the lower edge of the workpiece just clearing the bed. Thus the "T" slots were milled out, again in stages. But for this operation I was compelled to slide the whole assembly over the table to clear the cut, a check bar lying against the angle-iron rear edge preserving alignment.



BRACKET FOR COLUMN



FEED SCREW BRACKET



CROSS TRAVERSE TOP SLIDE

(*To be concluded*)